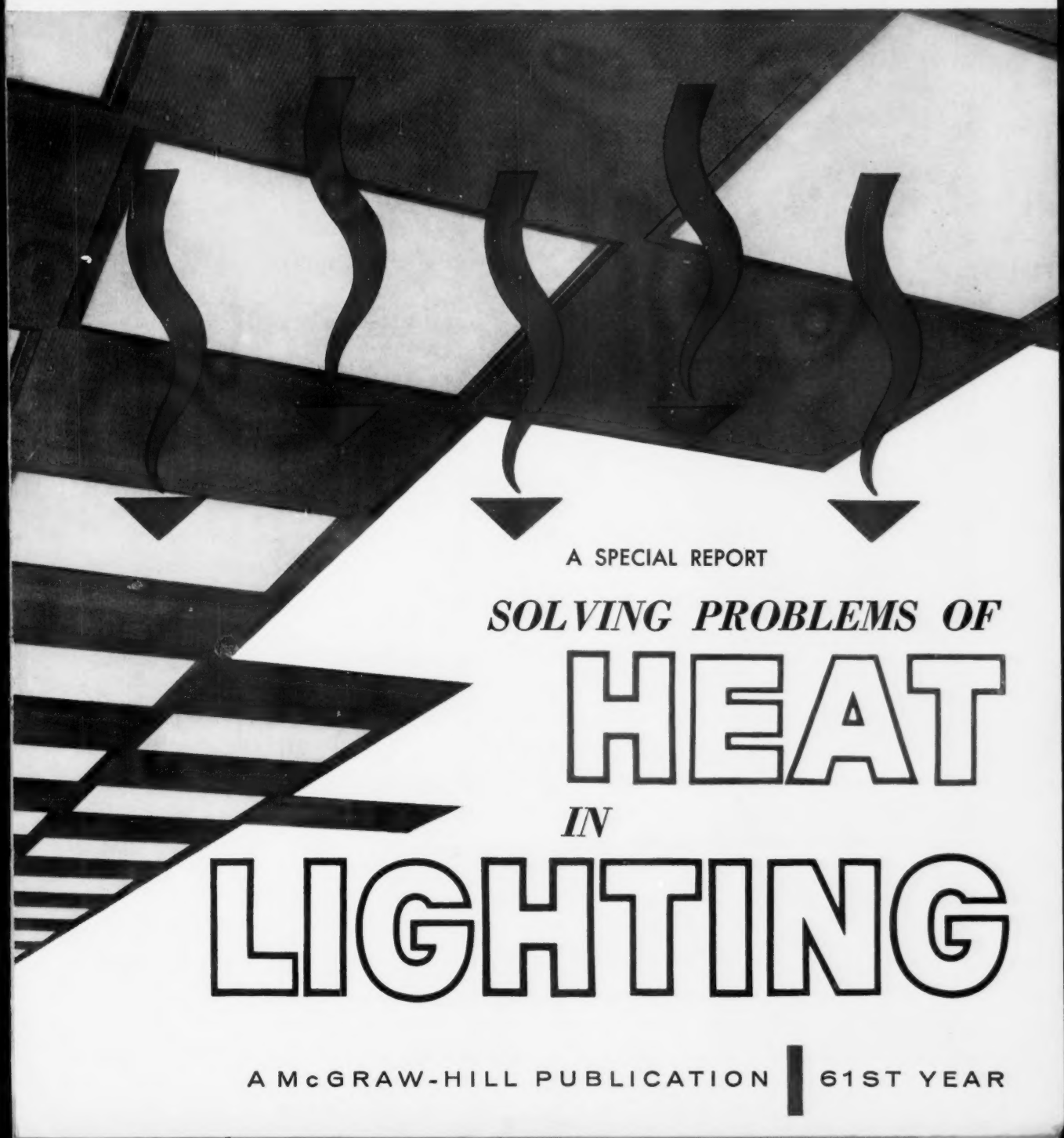
OCTOBER
1961

PRICE 75 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING



A SPECIAL REPORT

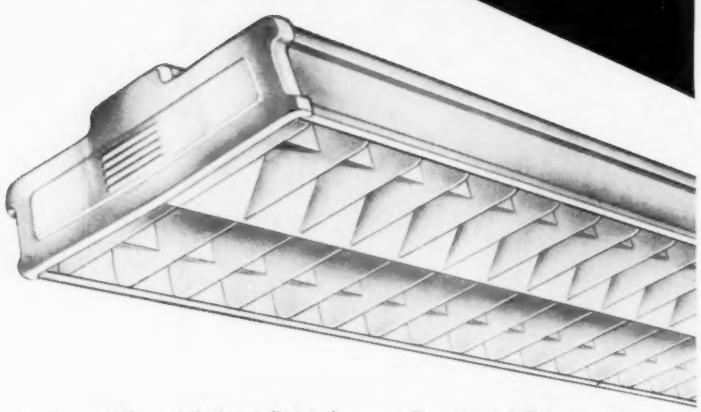
SOLVING PROBLEMS OF HEAT *IN* LIGHTING

A McGRAW-HILL PUBLICATION | 61ST YEAR

it's the finish that counts!

GUTH ACRYLIC LIGHTING FIXTURE FINISH

stays whiter and cleaner longer



Unless you specify acrylic-base finish for your fluorescent fixtures (at no extra cost!), you are handicapped like a racer with brakes on.

Brilliant Acrylic finish always looks like new. It stays sparkling white longer — is easier to clean (dirt and dust can't embed itself in this 175% harder finish) — is tougher and resists to chipping and scratching — and discolors less when exposed to ultraviolet.

Take a look at the chart below . . . and you'll always specify Acrylic finish for fluorescent fixtures. Don't be satisfied with less when you can have something twice as good — AT NO EXTRA COST!

THE EDWIN F. GUTH CO. 2615 Washington Blvd. Box 7079, St. Louis 77, Mo.

	Adhesion To Metal	Humidity Resist.	Salt Spray Resist.	Fume Resist.		Stain Resist.	Grease Resist.	Hardness	Mar Resist.	Reoperated Adhesion	Baking Color Stability	Heat Resist. (1)	Color Reten. Exposed to Ultraviolet
				Grease	Tobacco Smoke								
GOOD QUALITY FINISHES	8.0	8.5	8.5	7.5	6.5	5.0	7.0	8.0	8.5	8.5	7.5	5.0	6.0
NEW GUTH ACRYLIC FINISH	9.5	10.0	9.5	8.5	9.0	9.0	10.0	22.0	9.5	10.0	8.5	9.0	9.0
PERCENT BETTER	18.75%	17.65%	11.76%	13.33%	38.46%	80.00%	42.86%	175.00%	11.76%	17.65%	13.33%	80.00%	50.00%

(1) 30 min. at 400° F.

NEW FROM SQUARE D

NEW handle design permits ganging on 9" centers

NEW enclosure —most compact on the market

NEW larger gutters for aluminum wire

NEW lay-in lugs for easier wiring

VISIBLE BLADES for safety you can SEE

QUICK-MAKE, QUICK-BREAK mechanism

EXCEEDS Nema LD switch standards

Also available in raintight construction

THIS IS SQUARE D's NEW 60 AMP GENERAL DUTY SAFETY SWITCH

—forerunner of a complete line of General Duty switches to follow. Here again is design leadership *in action*—leadership which has made Square D switches the predominant first choice for 57 years. They cost no more... why settle for less?

For descriptive literature address Square D Company, Mercer Road, Lexington, Kentucky

SQUARE D COMPANY

wherever electricity is distributed and controlled

Form 85 Unilets

The advantages of aluminum combined with Appleton manufacturing standards for dependable performance now make available a wide selection of rugged, serviceable pressure cast aluminum fittings to give you easier electrical installations . . . faster, more economical!

Your distributor has them now. The complete line includes seven of the most popular types in ½", ¾" and 1" sizes to meet most job requirements. When you use them, you will agree . . . they are outstanding in every respect—from design to manufacturing excellence.

BEFORE YOU BUY OR SPECIFY . . . CHECK THESE APPLETON QUALITY FEATURES

Easy to use—roomy • Lightweight—durable • Taper Tapped threading • Precision hub alignment • Chamfered hub edges • Pressure cast smoothness • Reinforced points of stress • Easy-to-read cast identification • Attractive, practical design • Low cost—high quality • Wide assortment of covers available.

Contact your distributor or write for bulletin No. AL 60. It includes details for the entire *aluminum* product line by Appleton: Form 85 and larger sizes in Form 35 Unilets, FS and JB fittings and V-51 lighting fixtures.

Sold through franchised distributors only

Also manufacturers of:

Explosion-Proof Lighting Fixtures

Industrial Lighting

Automatic Reslites

Outlet Boxes, Covers, Switch Boxes

APPLETON electric company

1701 Wellington Avenue, Chicago 13, Illinois

ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electrogist and Electrical Record — Established 1901

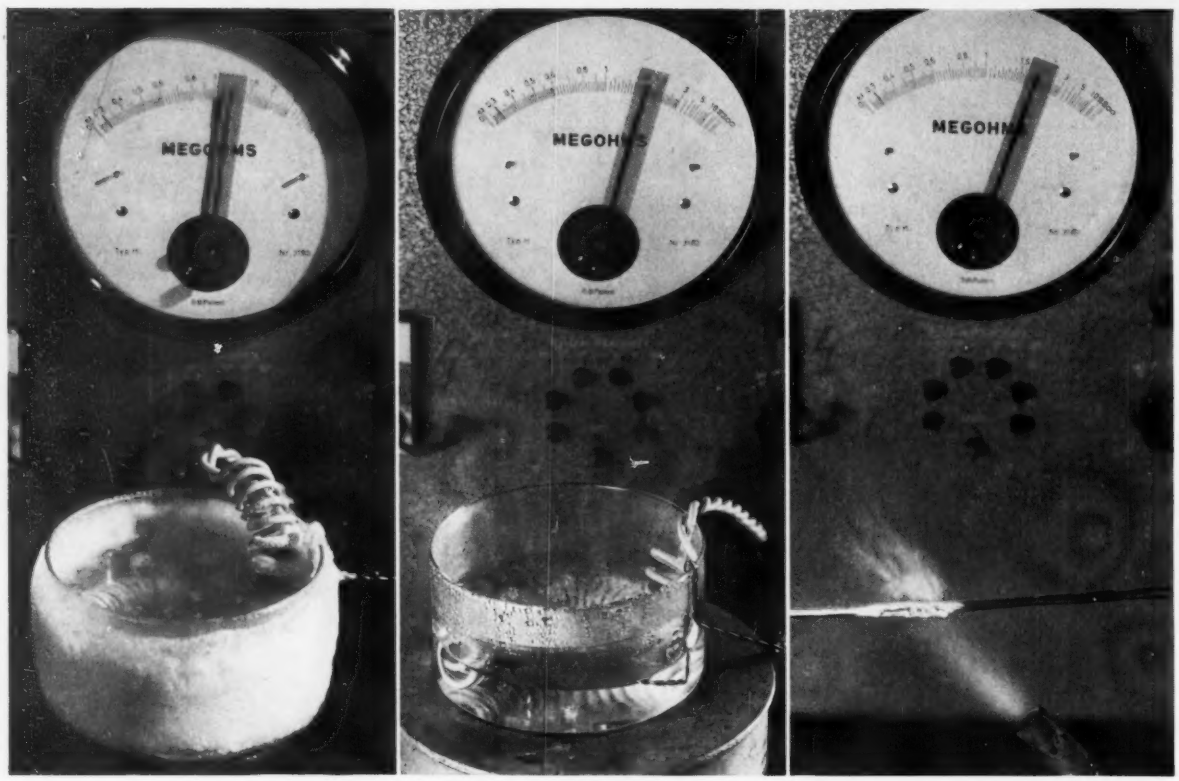
Published for electrical contractors, electrical departments in industry, engineers consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

61ST YEAR • OCTOBER 1961

MORE

SILICONE NEWS from Dow Corning

Frozen...boiled...burned

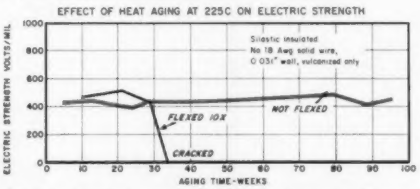


Silastic insulation maintains its properties from −90 to 500 F.

When mercury freezes, Silastic®, the Dow Corning silicone rubber, is still flexible. Fact is, Silastic insulation is ideal for temperatures as low as −90 F . . . easily withstands sleet, snow, ice and adverse weather you'd expect to find in the polar regions.

In a hot stew? Specify Silastic! Even 500 F has little effect on the properties of Silastic. That's why many industrial plants use Silastic insulated wire and cable. Strip mills, rolling mills, and metal forming plants (where high temperatures, humidity, chemical splash and fumes are common environments) are but a few of the installations using the properties of Silastic to provide cable dependability and long life.

To air-condition Hades would be a rugged assignment. However, if you were engineering the job you should specify power cables insulated with Silastic. Even if the Silastic burns, the ash is nonconductive. The line can carry a normal load as long as the ash remains intact and dry. This unique property of Silastic has been of primary importance in the protection of vital communication centers in both Navy shipboard and commercial installations.



Silastic insulation retains dielectric strength over a wide temperature span. What's more, its electrical properties are extremely stable and survive relatively unchanged even after long storage, weathering, thermal aging or heat cycling.

Write Dow Corning Corporation, Midland, Michigan, Dept. 3622, for a list of wire and cable manufacturers who use Silastic.

first in silicones

Dow Corning

ELECTRICAL CONSTRUCTION AND MAINTENANCE

OCTOBER • 1961 *continued*

Vol. 61, No. 10 ELECTRICAL CONSTRUCTION and MAINTENANCE OCTOBER 1961

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"Home buyers will go for an improvement like that. Thanks for suggesting it!"

This is a typical comment after the Graybar man spells out a new item to help an electrical contractor.

And many are the practical suggestions the Graybar man makes in the course of his calls. For he knows "what's cooking." He's wide awake to the new developments in home lighting, for example. He's a bug on high efficiency, time-saving tools and equipment. But whether he talks entrance panels, wiring devices, tools, fixtures or other, he makes it *his* business to improve *your* business.

Moreover, the Graybar Field Salesman is just one of four experts who make up the Graybar contractor service team. The others: Inside Salesman, Counterman, Specialist. And somewhere along the line all four can be of substantial help to you . . . *can help you improve your business . . . reduce your costs . . . speed your work.*

It will pay you to know Graybar better. Call us. 915

Graybar Service includes: Objective recommendations • On-the-job technical help • Most complete lines • Planned stocks to meet your needs • Expert counter service • Speedy handling of will-calls.

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ELECTRIC COMPANY, INC.

Everything Electrical GraybaR ELECTRIC COMPANY

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • OFFICES IN OVER 130 PRINCIPAL CITIES

Sidelights

LIGHT AND HEAT

As lighting systems have developed to meet higher standards of performance, they have called for higher levels of energy input which appears ultimately in the form of heat. Today's high performance installations and the prospects for even greater utilization are compelling more sophisticated attention to handling the heat output from lighting. In many areas it may be a substantial fraction of comfort heating requirements. It is already an important factor in the design of air conditioning systems. And, recently, the coordination of lighting equipment with air conditioning distribution has become one of the most significant developments of these times. In recent months Associate Editor Berlon C. Cooper has been interviewing many of the top industry authorities currently dealing with this complex subject in preparation for the special editorial report which begins on page 87. "Solving Problems of Heat in Lighting" is an original and exclusive article prepared specifically to serve the practical interests of our readers.

HOSPITAL ELECTRIFICATION

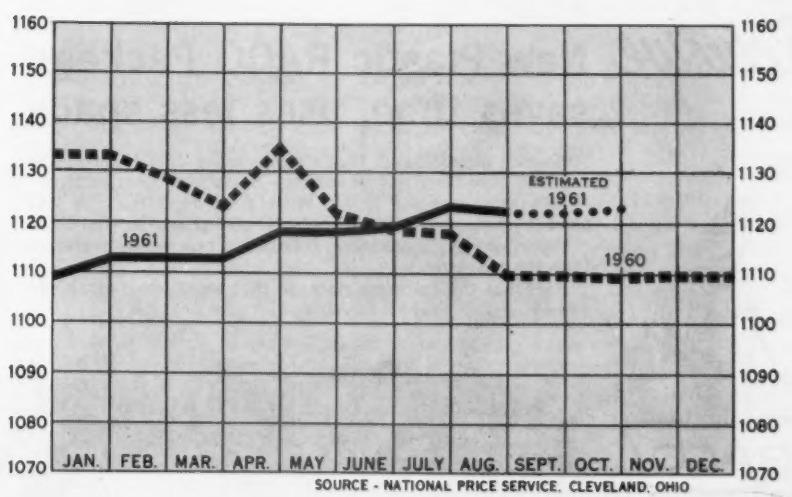
The vital role of electrical systems and equipment in modern hospital operation is exemplified in the design and construction of the new Houston Negro Hospital in Houston, Texas. Here a 460-volt distribution system serves a wide range of essential loads including an all-electric kitchen and electrically operated beds. The Howard P. Foley Company was the electrical contractor, and Dowell Weeks of Bernard Johnson and Associates, the electrical engineer. Mr. Weeks describes the project in "Modern Hospital Electrification" beginning on page 103.

CIRCUIT IDENTIFICATION

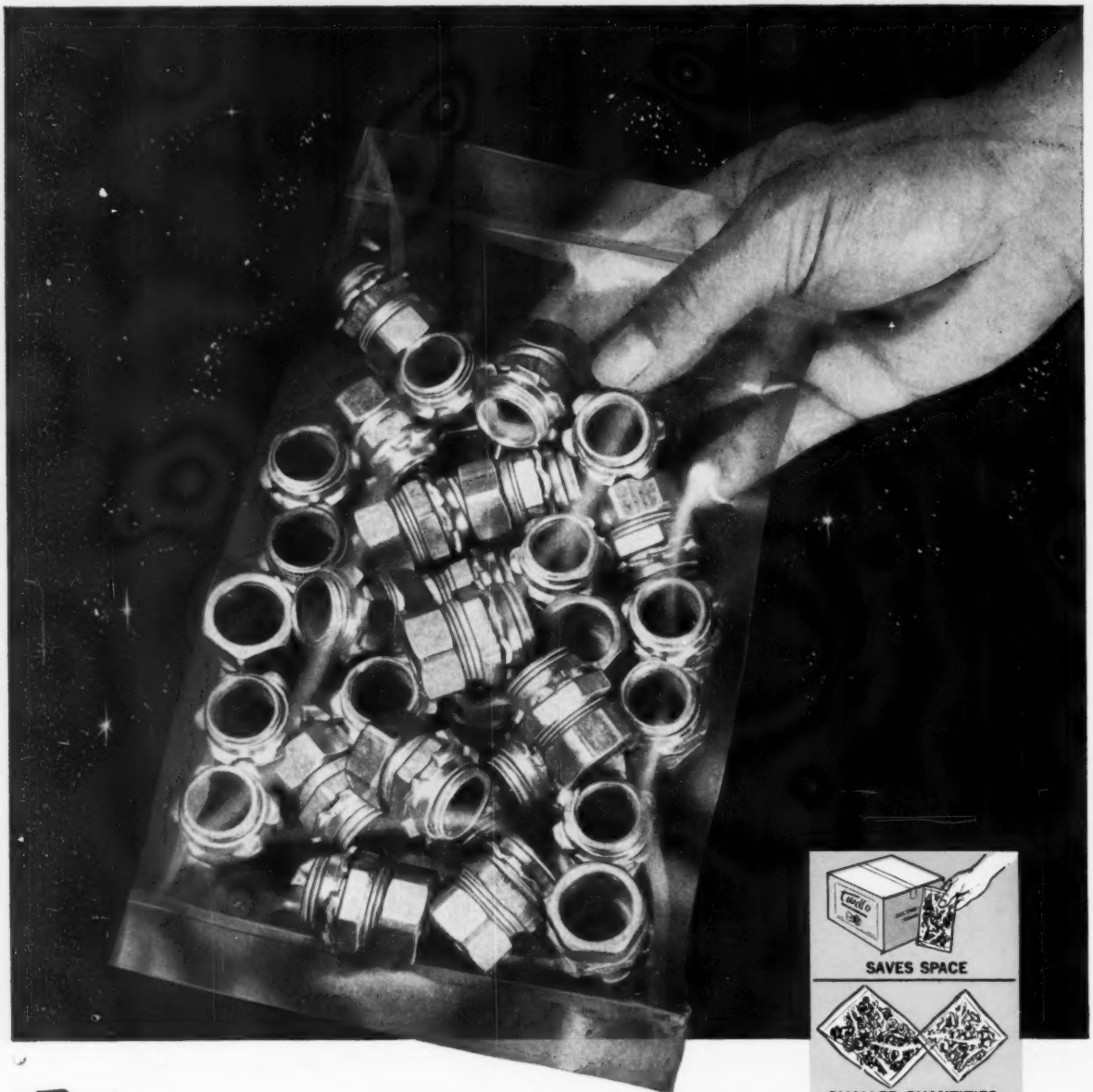
How colors, letters and numbers put together in the form of a code can simplify and expedite complex industrial electrical systems installation and maintenance is described this month by Otto W. Walther, Walther Electric Co., Hughson, Calif. His system and code using color-coding of power and control conductors, a logical system of making equipment and ASA designated methods of terminal identification has proved to be highly successful. "Circuit and Equipment Identification Pays Off" begins on page 112.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



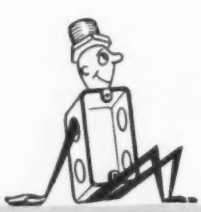
SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO



Exclusive **New Plastic RACO Package saves time, uses less space**

Fittings in plastic bags? That's right. Heavy duty, clear plastic bags are now carrying and holding—in place of inner cartons—Raco's most popular items. What a savings! You use less storage space. Quantities are smaller and geared to your more practical needs. Furthermore, fittings are completely protected from the elements.

Raco has the complete package that saves you time, helps you earn more. Prove it to yourself on your next job.



RACO®

ALL-STEEL EQUIPMENT INC., Aurora, Illinois

Washington Report

OCTOBER • 1961

Business outlook for fourth quarter is good, but not as rosy as Washington economists proclaim, even when based on their own statistics. Total business activity in the third quarter, as measured in gross national product (all goods and services) was about $526 billion, at an annual rate, and the prediction is for a $540 billion annual rate for the upcoming fourth quarter. The fourth quarter will thus be about $25 billion, at an annual rate, above the second quarter of this year. When related to the quarter only, however, the fourth quarter total increase over the second quarter will be less than $7 billion.

Who will spend this $7 billion, and what goods and services will it be spent for? The greater part of it will be spent by government—federal, state and local. Consider the private sector of the economy, for example. With personal income at an all-time high, retail sales have bobbled along at a seasonally-adjusted monthly rate of $18 to $18¼ billion. Installment credit outstanding has shown declines in four months of 1961, and merely held its own in other months. And automobile credit outstanding has shown decreases each month of this year. Capital spending for new plant and equipment is increasing slightly, but is still about 3% under last year's rate. And new construction spending is up about 2% for the year, but with all of this increase attributed to public funds.

On the optimistic side, physical volume of production (FRB Index) is at a new high of 113% (of 1957 average), or 13% above the volume four years ago. This increase is primarily attributable to stepped up purchases by 1) government, for the military, and 2) business, for inventory. Steel production is now running in excess of 2 million tons weekly, and is expected to rise during this quarter, to meet increased demands for military hardware and new model autos. For a sustained rise in the economy, the impetus must come from increased consumer spending, and there have been few indications that this will happen.

New construction spending in August was 4% ahead of year-earlier rate, at a seasonally-adjusted annual rate of $58.3 billion. Outlays for the month were $5.4 billion, up 1% from July. Publicly-financed projects were up 4% from the July level.

Privately owned electric utilities have plans for spending about $8 billion over the next nine years, to 1970, to add 100,000 more miles to the nation's 364,000 miles of transmission lines.

Housing starts declined in August for the second straight month, to a seasonally-adjusted annual rate of 1,317,000, which was below the July rate, and below the 1,335,000 annual rate in August 1960. Demand determines the rate at which new homes will be built, and evidence mounts that the demand just isn't there, and Government programs to aid housing cannot repeal the law of supply and demand.

For-sale vacancies of existing houses were 1.4% during the second quarter of this year, according to Dept. of Commerce estimates, up from about 1% over the past three years. Also, rental vacancies were up to 8.1% in the second quarter, compared with 7.3% a year earlier. However, alterations and repairs by homeowners and tenants are up sharply, and totaled about $13 billion in 1960.

Chosen to protect your children

. . . a prime essential to all business construction

Chances are great that you pass a Gamewell fire alarm box on your way to work, because a vast majority of all municipal fire alarm systems are Gamewell systems!

For over 100 years Gamewell fire alarm boxes have stood as silent sentinels in thousands of communities. The lives and the property these systems have saved are testimony of their unerring reliability. Similar Gamewell interior fire alarm systems, with the same high standards and offering the same reliability, can be planned as part of complete plant and institutional fire protection. Safety is everybody's business . . . *our* profession.

Send for your Gamewell Flexalarm catalog with typical fire alarm installations, see how you can plan maximum protection at minimum cost. Write THE GAMEWELL COMPANY, 1322 Chestnut Street, Newton Upper Falls 64, Massachusetts. A Subsidiary of E. W. Bliss Company.

BLISS Gamewell®

FIRST... WHEN SECONDS COUNT

1

Bid Kaiser Kingfisher Aluminum for top crew speed (it weighs 1/3 as much as steel, cuts work up to 42%)

At 10¢ a minute,* why make electricians gang up to hoist heavy conduit? . . . haul it to power benders? . . . lose time cutting through galvanized steel? Kaiser Kingfisher Aluminum conduit—weighing only one-third as much as steel—is easier to haul, cut, thread, bend. Hanging is faster, because runs can be preassembled. You save up to 42% in labor bidding with Kingfisher conduit.

KAISER ALUMINUM

KAISER ALUMINUM AND CHEMICAL CORP.
KAISER CENTER, OAKLAND, CALIFORNIA.

* Typical all-inclusive cost per man.

COMPARISON: 1¼-inch conduit	Galvanized Steel	Kaiser Aluminum Kingfisher
Weight, per 100 ft.	200 lbs.	79.8 lbs.
Cutting	Blade cutter 3 minutes	Saw or wheel cutter 1 minute
Threading time floor to floor	2 minutes	50 seconds
Bending crew	Two men or power bender	One man with hickey
Manhours per 100 feet, service 12′ ceilings	6.5 hours	4.9 hours

Photo: This 10′ length of 4″ aluminum conduit weighs less than 40 lbs. Steel would weigh almost 100 lbs.

EASIEST TO USE BUILT-IN WRENCH

EASIEST TO USE BUILT-IN WRENCH

EASIEST TO USE BUILT-IN WRENCH

IDEAL **WING-NUT**

easiest to use--
built-in wrench

A twist of your wrist makes a perfect wire splice with a Wing-Nut. You don't need tools—even on the toughest branch circuit wires.

Unique wings provide a natural grip. Because of the leverage with this "built-in" wrench, Wing-Nut is twice as easy to apply as other connectors. Internal spring tension makes the splice tight. The only way Wing-Nut will come off is for *you* to remove it.

You can actually see your splice through the semi-transparent Nylon shell, the strongest used on any connector. And the wide, deep Wing-Nut skirt slips easily over a wire combination as large as two No. 8 and a No. 6, even thick type RW insulated wire. In crowded boxes just clip the wings off after applying.

Wing-Nut has unqualified listing as a pressure cable and fixture splicing connector for 474 combinations of solid and stranded copper wire. Plus all common aluminum-to-aluminum combinations. Honestly, until you try Wing-Nut, you've never made splices so good, so easily. See for yourself. SEND FOR FREE SAMPLES.

Sold through America's Leading Distributors
In Canada: Irving Smith Ltd., Montreal

IDEAL INDUSTRIES, Inc.
1041-J Park Avenue, Sycamore, Illinois

2

Install Kingfisher for trouble-free Conduit runs (rust-free aluminum reduces future maintenance)

Aluminum means lasting conduit protection because it won't rust. It also means a safer electrical system, because aluminum conduit walls are highly conductive. The contractor whose business depends on his reputation will find Kaiser Kingfisher the surest way to profitably deliver a professional, lasting conduit system. It will remain trouble-free, saving maintenance in years ahead.

KAISER ALUMINUM

KAISER ALUMINUM AND CHEMICAL CORP.
KAISER CENTER, OAKLAND, CALIFORNIA.

CORROSION-RESISTANCE ADVANTAGES OF ALUMINUM

Excellent for burial in concrete.
Interior will not rust.
Less affected by chemical environment than zinc or steel.
Less affected by atmospheric corrosion than zinc or steel.
No rust to stain buildings.

ELECTRICAL ADVANTAGES OF ALUMINUM

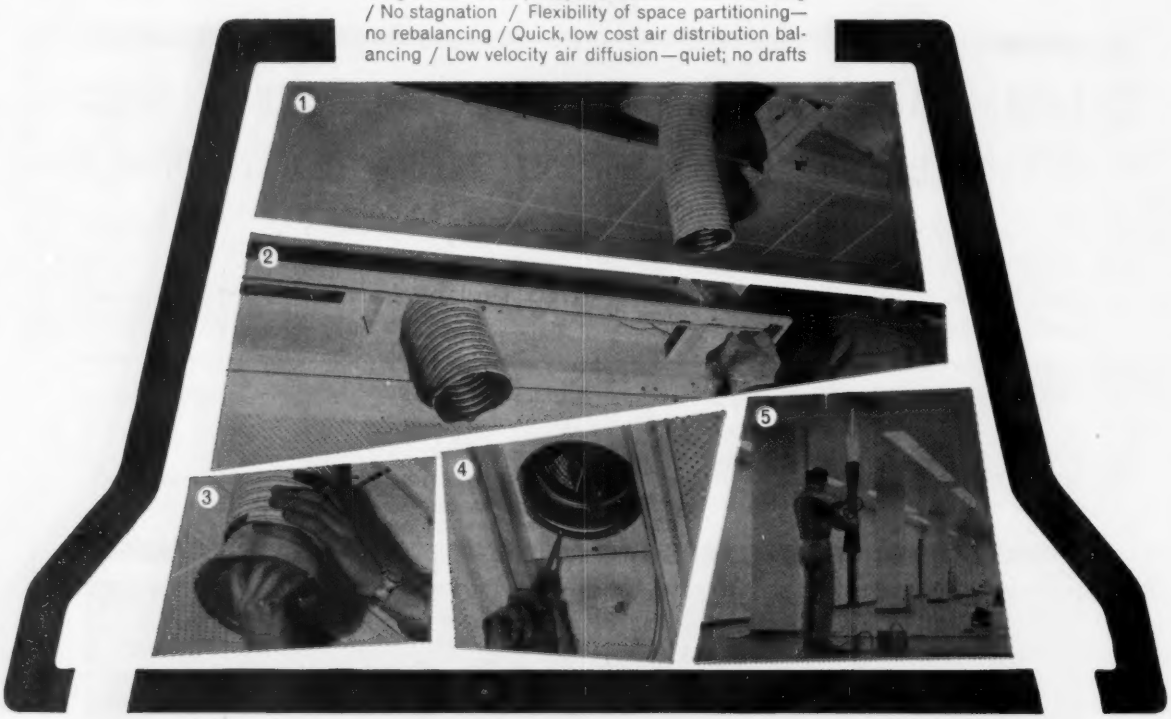
Lower voltage drop.
Five times as conductive as steel.
Continuous ground not interrupted by rusted thread connections.
Non-sparking. Approved by NEC for hazardous locations and wherever RIGID metal conduit is required.

Photo: Kaiser Aluminum conduit was chosen for corrosion-resistance in this new mine of Morton Salt Co., in Ohio.

LOWEST TOTAL COST

The Multi-Vent system's unique design and engineering enables you to gain the advantages of combining light and air distribution at lowest cost. This applies to initial installation, operation, and maintenance costs, whether the totals be compared with separate systems for providing lighting and air conditioning, or for other combination systems. Take maintenance costs, for instance—by diffusing the air straight down at low velocity, *Multi-Vent prevents ceiling or wall smudging* and thereby *reduces cleaning and redecorating costs.* And, ... Here's A Union Approved Procedure that Helps Keep *Installation* Costs Low. **1.** Flexible tubing dropped through fixture opening in completed ceiling. **2.** Troffer installed—tubing extending through 5" knockout **3.** Air valve assembly conveniently attached to the tubing from below **4.** Completed ceiling without access through ceiling **5.** Exclusive "Venturi" simplifies accurate balancing.

THE MULTI-VENT SYSTEM GIVES YOU THESE OTHER IMPORTANT BENEFITS More light output / Longer ballast life / Superior room air conditioning / No stagnation / Flexibility of space partitioning—no rebalancing / Quick, low cost air distribution balancing / Low velocity air diffusion—quiet; no drafts



THE MULTI-VENT SYSTEM OF LIGHTING AND AIR DIFFUSION

THIS SYSTEM IS AVAILABLE FROM THE FOLLOWING MANUFACTURERS:

***COLUMBIA**, Columbia Lighting, Spokane, Washington*

***MILLER**, The Miller Co., Meriden, Connecticut*

***PYLE-NATIONAL**, The Pyle-National Company, 1334 N. Kostner Avenue, Chicago 51, Illinois*

***SYLVANIA**, Sylvania Electric Products, Inc., Wheeling, West Virginia*

3

Be sure it's Kaiser Kingfisher Prime 6063 Alloy ("pot luck" substitutes can pile up costly labor)

Kaiser Kingfisher conduit is extruded from uniform prime 6063 aluminum conduit alloy. It always has uniform T-42 temper for easy bending... full wall thickness ...uniform threads, lubricated both ends.

As a result, you can standardize each operation. You can work accurately at top speed, with minimum equipment. This is not true of "pot luck" conduit made without quality control. If conduit is too soft, bends collapse. If too hard, work slows. These and other variations of "pot luck" conduit can nickel and dime you to death.

For conduit savings you can rely on, specify Kaiser Kingfisher—prime metal controlled from mine to market by the leading manufacturer of aluminum conduit. It's uniform in every delivery.

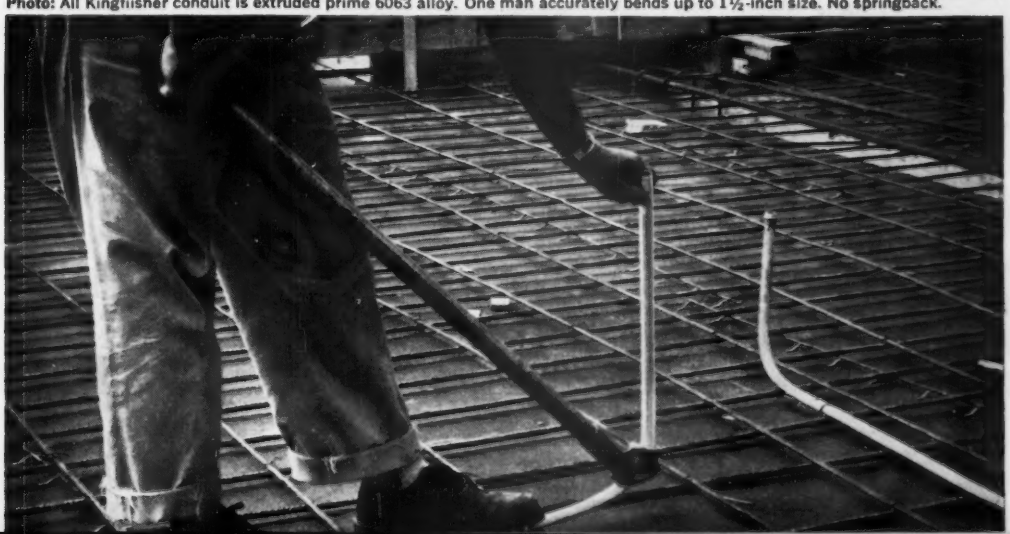
Another reason to buy Kaiser Kingfisher—Thread-Saving Forged Couplings

Only Kaiser Kingfisher offers forged couplings with its conduit. The stronger threads of these couplings will chase damaged threads—save hours of rethreading.

KAISER ALUMINUM

KAISER ALUMINUM AND CHEMICAL CORP.
KAISER CENTER, OAKLAND, CALIFORNIA.

Photo: All Kingfiisher conduit is extruded prime 6063 alloy. One man accurately bends up to 1½-inch size. No springback.



Mr. Joseph F. Slavik, Detroit, Michigan. Among his building citations, Mr. Slavik includes awards from *The Saturday Evening Post, Look, American Home, House & Home, Practical Builder* and the *NAHB Journal.*

The Americana, Burton Hollow, Livonia, Michigan. Detroit Home Builders Association "Idea Homes Award" winner. House and grounds: $27,000.

"Good promotion ideas help sell houses. That's why I use concealed telephone wiring"

SAYS MR. JOSEPH F. SLAVIK,
PRIZE-WINNING BUILDER OF DETROIT, MICHIGAN

"Concealed telephone wiring with planned outlets is one of our chief sales features," says Mr. Slavik. "People look for it. They know it promises first-class, custom-built telephone service. So we promote it – and we use the Telephone Company's advertising for all it's worth. It all adds up to smart selling when we play up concealed telephone wiring.

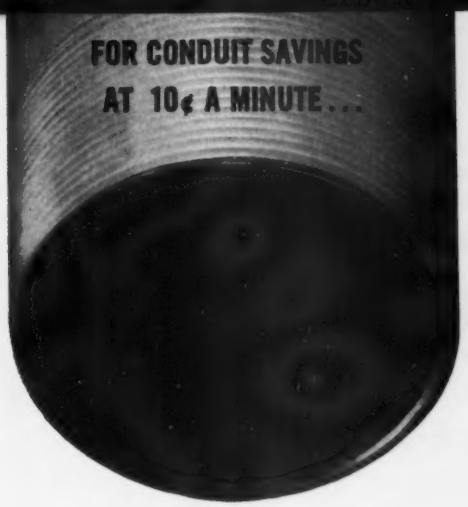
"Here in Burton Hollow we've had a lot of success selling telephone planning as an idea that adds to the looks, livability, and resale value of the home. That really puts pre-wiring in the buyer's language."

Mr. Slavik, one of the nation's leading builders, is currently building approximately 300 homes in the Detroit suburbs of Burton Hollow, Ann Arbor Woods and Lotus Lake (near Pontiac). His own sales promotion stresses complete telephone planning.

* * *

Your local Bell Telephone Business Office will gladly help you telephone plan your homes. For more information on telephone planning, see Sweet's Light Construction File, 11c/Be.

BELL TELEPHONE SYSTEM



4

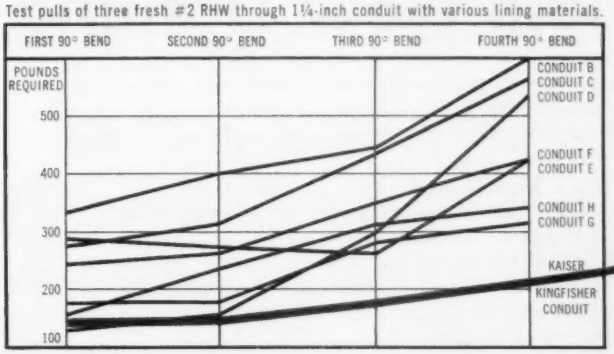
Get a dividend in Kingfisher K-40 Silicone Lining (lets cables slip through with 39 to 61% less pull!)

Get Kaiser Aluminum and K-40 too! This amazing all new silicone lining—exclusive in Kaiser Aluminum Kingfisher conduit—has been tested against other types of linings. As shown in the chart below, slick K-40 beats them all. It required 39% less pull than galvanized steel at the third bend...61% less pull at the fourth bend. A big difference in labor!

To be sure of all the savings of Kaiser Aluminum conduit—plus exclusive K-40 silicone lining and forged couplings—specify Kaiser "Kingfisher" by name.

POUNDS OF PULL REQUIRED—ALUMINUM AND GALVANIZED STEEL CONDUIT

Test pulls of three fresh #2 RHW through 1¼-inch conduit with various lining materials.



BE SURE IT'S KAISER ALUMINUM

KINGFISHER

RIGID ALUMINUM CONDUIT WITH K-40 SILICONE LINING

STOCKS NOW THROUGHOUT THE COUNTRY AT LEADING DISTRIBUTORS.

KAISER ALUMINUM

KAISER ALUMINUM AND CHEMICAL CORP., KAISER CENTER, OAKLAND, CALIFORNIA.

See FOLLOW THE SUN and MAVERICK weekly, ABC-TV Network.

L-M'S TRADITIONAL LAWN-GLO luminaire combines elegant, graceful design with an efficient modern optical system. Shatterproof acrylic refractor panels direct the light down, eliminate glare, provide efficient light distribution.

L-M's Traditional Lawn-Glo(TM) Light Offers Whole New Lighting Concept

Line Material's new Traditional Lawn-Glo luminaire combines the charm and style of an Early American whale oil lantern with the efficient, controlled illumination of the Lawn-Glo's scientifically designed modern optical system.

The Traditional Lawn-Glo luminaire offers impressive size, tasteful elegance, and long-life, all-aluminum die-cast construction.

The side panels are shatterproof acrylic plastic refractors, with thousands of prisms that direct the light down, not up and out where it is wasted. Available in handsome black and gold, or white and gold finish. It's a good-sized unit—20 inches tall, 12½ inches wide. Takes up to 150-watt lamp; for 3-inch mounting.

Line Material, a leader in outdoor lighting for half a century, offers a complete line of fluorescent, mercury, and incandescent luminaires. Equipment is specially designed for the application and includes luminaires for parks, parking areas, airports, shopping centers, hotels and motels, streets and malls, and many other building and architectural applications. Line Material also makes available, through Authorized L-M Distributors, complete Lighting Application Engineering Service.

Get Details on L-M's Complete Line

Contact your electrical distributor, or Line Material Industries, Milwaukee 1, Wisconsin. In Canada: CLM Industries McGraw-Edison (Canada) Limited. Toronto 13, Canada.

OTHER L-M LAWN-GLO LIGHTS

—three styles, available in choice of six decorator colors and brushed aluminum.

MAIL THIS COUPON

Line Material Industries, Milwaukee 1, Wisconsin ECM-101

Please send me details on Lawn-Glo units and the entire L-M line of specialized outdoor lighting equipment, and name of nearest Authorized L-M Distributor.

Name _____

Company _____

Address _____

City _____ State _____

Type of Business _____

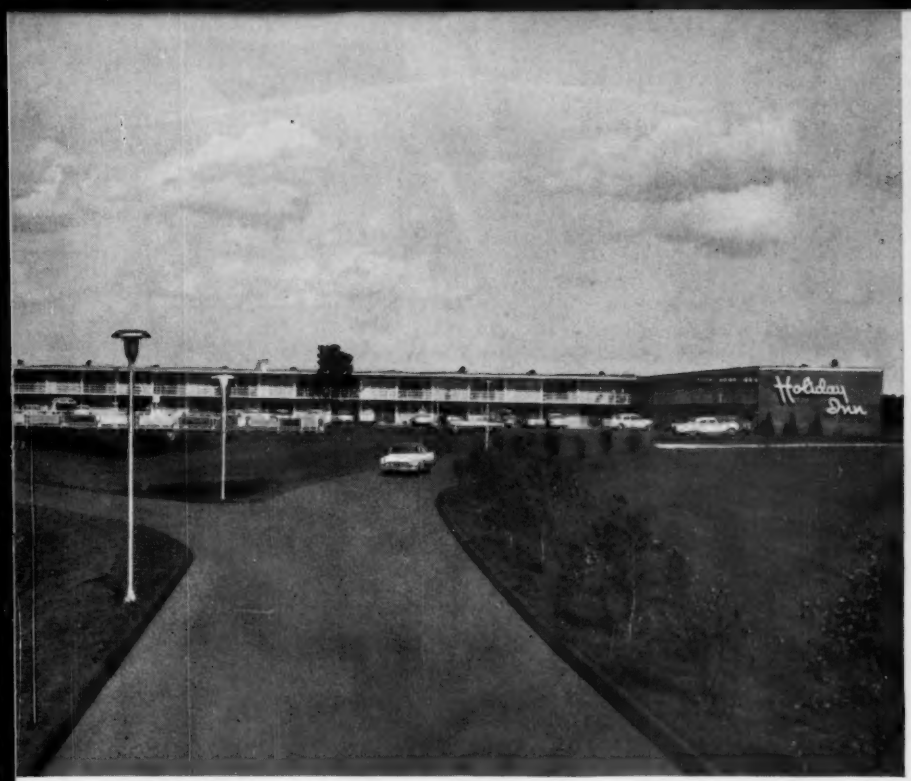
LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

Outdoor Lighting McGRAW EDISON

531

DISTRIBUTION TRANSFORMERS · RECLOSERS, SECTIONALIZERS AND OIL SWITCHES
FUSE CUTOUTS AND FUSE LINKS · LIGHTNING ARRESTERS · POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS · CAPACITORS · REGULATORS · OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS · PORCELAIN INSULATORS · FIBRE PIPE AND CONDUIT



L-M PTL'S AT HOLIDAY INN MOTEL, Springfield, Missouri. PTL luminaires are weatherproof, in brushed aluminum or choice of six decorator colors. Exceptionally easy to install. Top reflector simply tilts for maintenance or relamping. With or without photocontrol, for incandescent or mercury with built-in ballast. Choice of seven IES light patterns.

L-M'S STYLED MERCURY, the ultimate in styling for streets, parking areas, malls, shopping centers, etc. Available in 1000, 700 or 400 watt luminaires.

L-M LAWN-GLO LUMINAIRE available in traditional or three contemporary designs. For homes and commercial applications where soft, low-level lighting is desired. High grade, all-aluminum unit with many desirable features; weatherproof; easily installed.

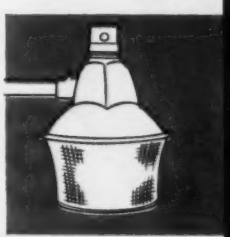
Increase Nighttime Traffic With L-M's Modern, Efficient PTL(TM) Luminaire

Contemporary styling and high lighting efficiency are combined in L-M's Post Top Light. The PTL luminaire has a scientifically designed optical system, with reflector-refractor combination that directs light down, not up and out where it is annoying.

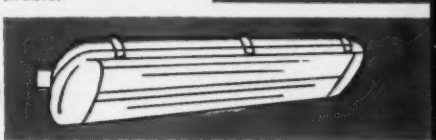
PTL'S can be installed anywhere; replace old-style units, or provide efficient lighting for new installations. Excellent for public and private applications for hotels, motels, pools, parks, marinas, driveways, amusement parks, shopping centers, churches, hospitals, and airports, because it directs the light down, not up.

Get Information on L-M Outdoor Lighting

L-M equipment is specifically designed for the application. L-M provides a complete line of luminaires, in a wide variety of types, in fluorescent, mercury, and incandescent. Also Lighting Application Engineering Service, available through Authorized L-M Distributors. Ask your electrical wholesaler, or mail the coupon.



L-M SUBURBANAIRE is available in mercury or incandescent. For farms, neighborhood streets, church grounds, parking lots, many other areas where medium-intensity efficient lighting is desirable.



L-M FLUORESCENT LUMINAIRES are available in a wide variety of styles for street, airport, subway and tunnel lighting. In choice of deep or shallow units.

LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

533

Outdoor Lighting

McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS
LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS
OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

MAIL THIS COUPON

Line Material Industries,
Milwaukee 1, Wisconsin ECM-101

Please send me information on the PTL, L-M's complete lighting line, and name of nearest Authorized L-M Distributor.

Name_____

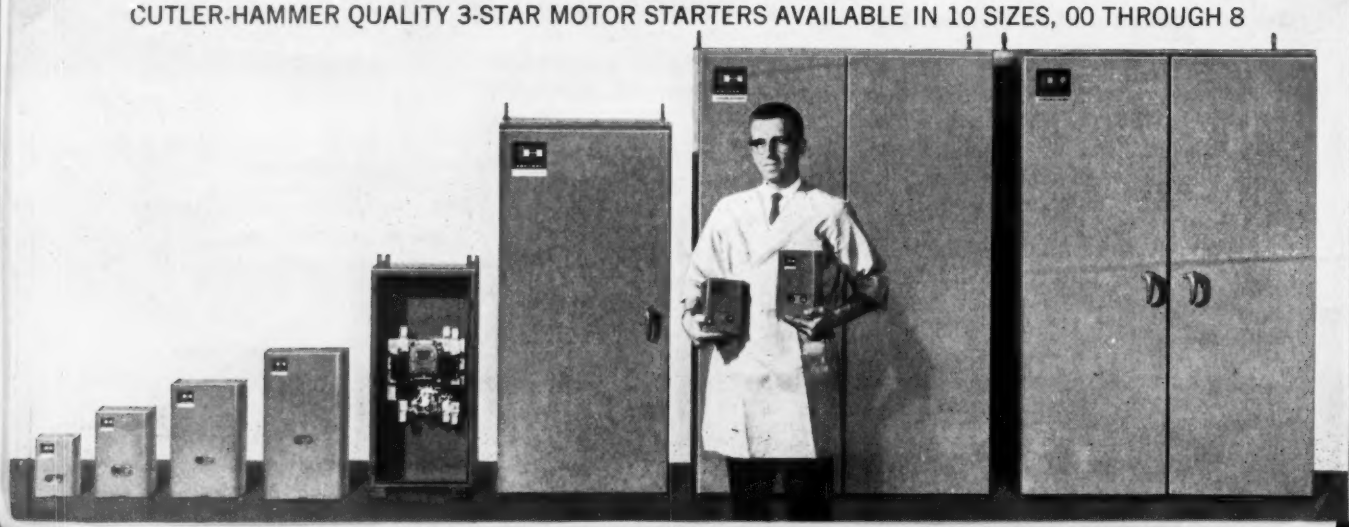
Company_____

Address_____

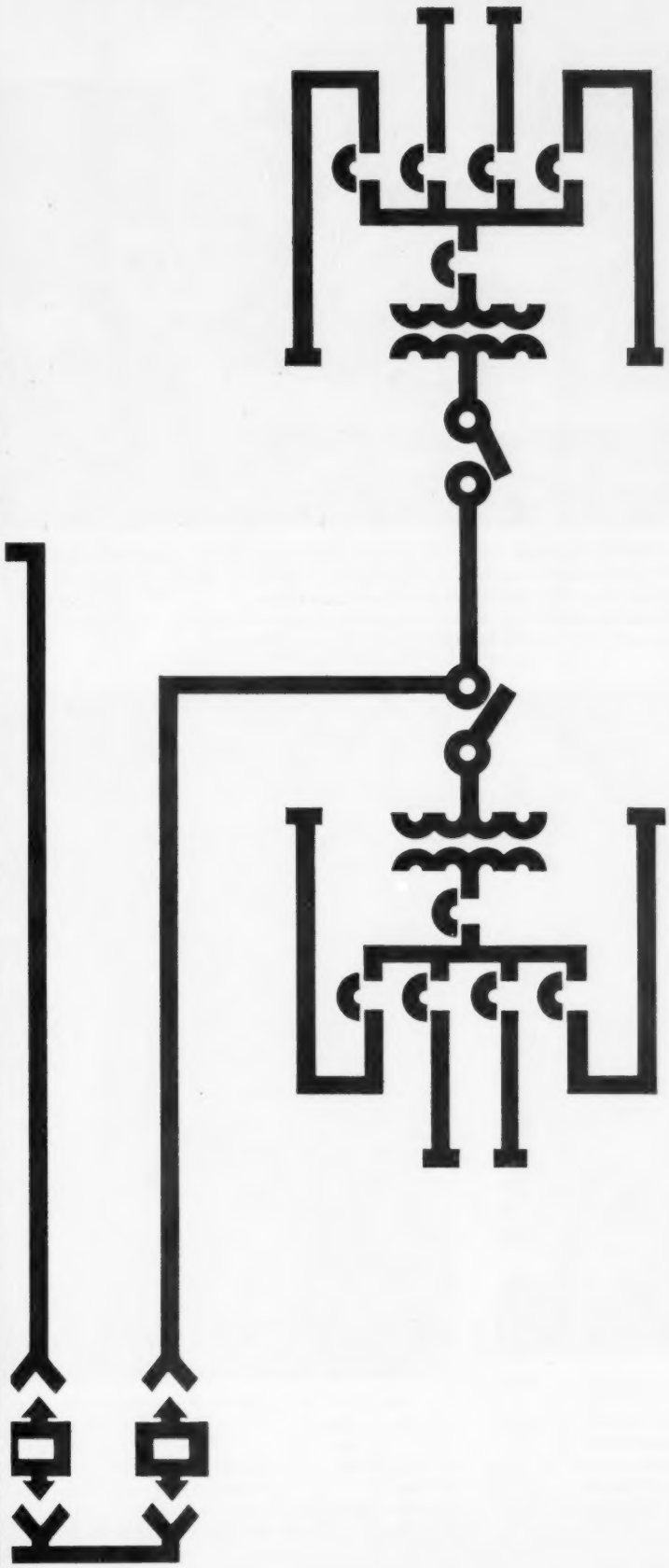
City_____ State_____

Type of Business_____

CUTLER-HAMMER QUALITY 3-STAR MOTOR STARTERS AVAILABLE IN 10 SIZES, 00 THROUGH 8



J-94174-1



Baptist Operations Building powers up to process 200 carloads of church literature yearly

In the nine-building complex that forms the Baptist Sunday School Board Headquarters in Nashville, Tenn., a new $5 million Operations Building is the hub of activity, forwarding books, pamphlets and supplies to the denomination's nine million members.

These pages show how Westinghouse helped assure electrical power adequate for present operations, with equipment designed to meet requirements for planned office space expansion. Another reason why you can be sure . . . if it's Westinghouse.

J-94174-2

Operations Building
Baptist Sunday School Board
Nashville, Tennessee

(*continued*)

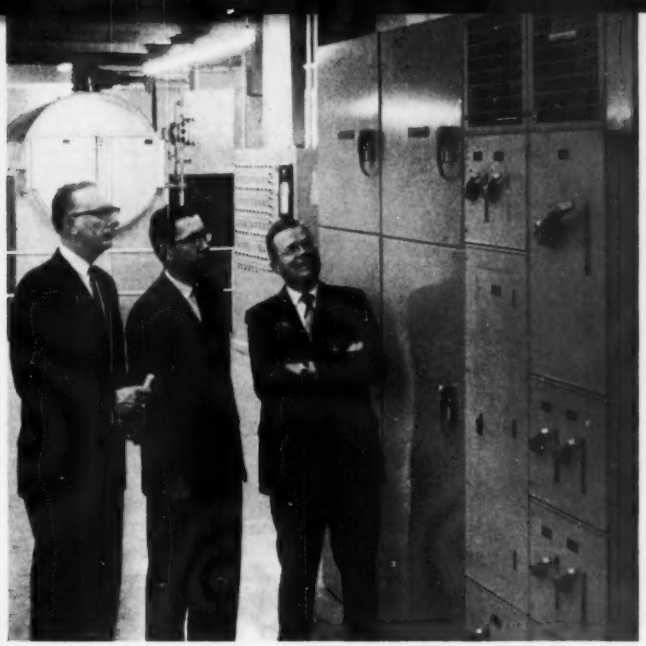
Owner: Sunday School Board of the Southern Baptist Convention, Nashville, Tenn.
Architects and Engineers: Hart, Freeland and Roberts, Nashville.
General Contractor: W. F. Holt and Sons, Nashville.
Electrical Contractor: Bond Electric, Nashville.
Electrical Distributor: Tafel Electric and Supply Co., Nashville.

C. R. Marshall (standing), Westinghouse, describes future capabilities of the electrical system to: E. B. White, Architect; James L. Sullivan, Executive Secretary-Treasurer, Sunday School Board; B. B. Boyd, Jr.,Consulting Electrical Engineer; Hardie Bass, Chief Architect for the Sunday School Board. Westinghouse helped coordinate electrical construction to insure economical future growth. Eventual expansion will add three production floors and a 12-story office annex.

J-94174-3

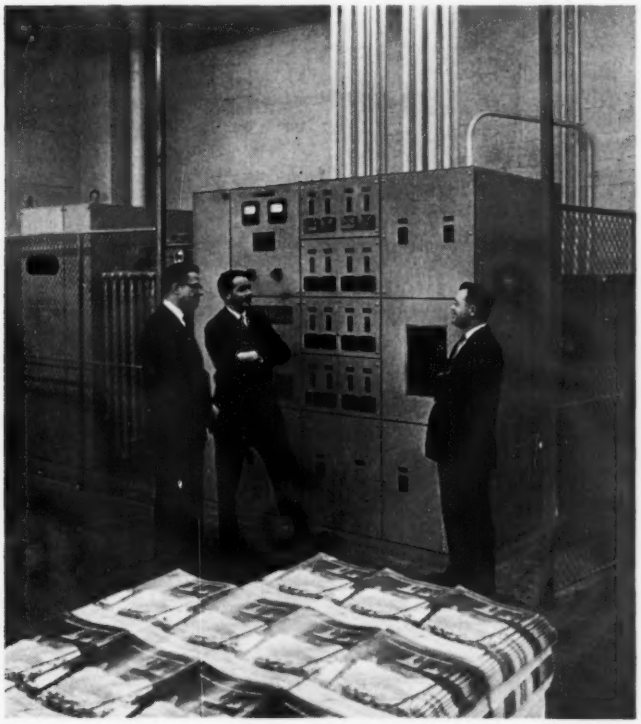
Lighting the main office area are 265 Westinghouse Type LC fluorescent luminaires. In this installation the fixtures are suspended from the ceiling; they can be surface mounted if desired. Metal side panels allow for easy maintenance and give a pleasing appearance, and the 35° by 25° metal louvers assure uniform brightness across the luminaire.

Discussing primary 5-kv indoor metal-clad switchgear, Hardie Bass, E. B. White and B. B. Boyd, Jr. Switchgear contains four 50-DH-75 air circuit breakers for feeders to the five power centers and HV starters. Draw-out construction of the Westinghouse unit allows for quick, simple withdrawal of the breaker element for inspection of contacts.



Motor Control Center conveniently groups all controls. William H. Donnell, Maintenance Supervisor, Sunday School Board; W. A. Cortner, Bond Electric, and J. R. Harrell, Tafel Electric, discuss two Ampgard® 2300-volt linestarters, at left, which control and protect 360-hp motors. Sections at right house 208-volt motor control.

W. A. Cortner and J. R. Harrell examine a Westinghouse column-type NLAB lighting panelboard. Quick-lag breakers in the panel give protection against both short circuits and overloads. Pull-box at the top makes connections easier, installation faster, neater.



As diagrammed on the previous pages, five unit power centers rated 2300 to 120/208 wye are strategically positioned to provide LV power at point of use. Seen at the low-voltage end of this 500-kva power center are B. B. Boyd, Jr., J. R. Miller, Westinghouse Construction Engineer, and J. R. Harrell. Tri-pac feeder breakers are used here to protect against high fault currents. Tri-pac combines AB De-ion circuit breaker and a current limiting device for use with fault currents up to 100,000 amps. Typical church literature can be seen in the foreground.

W. A. Cortner energizes a Westinghouse Lifeline Starter controlling a 5-hp air conditioning motor. Starter is operated easily with a start-stop push button mounted on the cover. At right is a 30-ampere 250-volt fusible safety switch with a quick break mechanism that prolongs contact life, gives years of trouble-free service.

J-94174-4

Westinghouse

SWITCH NOW AND SAVE THE DIFFERENCE

Here's how changing from copper to Rome's aluminum TW building wire can improve your profit picture

The figures in the table tell the story. An installation using *aluminum instead of copper building wire usually costs less.* Savings on wire cost vary with size, as indicated in the table. Simply select the size and multiply the difference in cost by the amount of wire required. It follows, too, that the more times you use aluminum, the more you save. And don't forget, lightweight aluminum is easy to handle. For example, 1000 feet of No. 1 AWG copper Type TW weighs 115 lbs. more than aluminum wire of equivalent current-carrying capacity. Those are pounds you *don't* load, unload or carry. The savings in dollars are obvious. And you'll appreciate the ease of handling with the first installation—and every one that follows. For the full story on Rome Aluminum TW wire, contact your nearby Rome distributor or sales representative. Or, write to Rome Cable Division of Alcoa, Dept. 7-101, Rome, N. Y.

Rome Synthinol Type TW with aluminum conductor is available in a full range of sizes starting with #6 AWG. Underwriters' Laboratories approved. The insulation, a thermoplastic compound, is flame-resistant, oilproof, easy to pull, free-stripping and has extremely high dielectric strength.

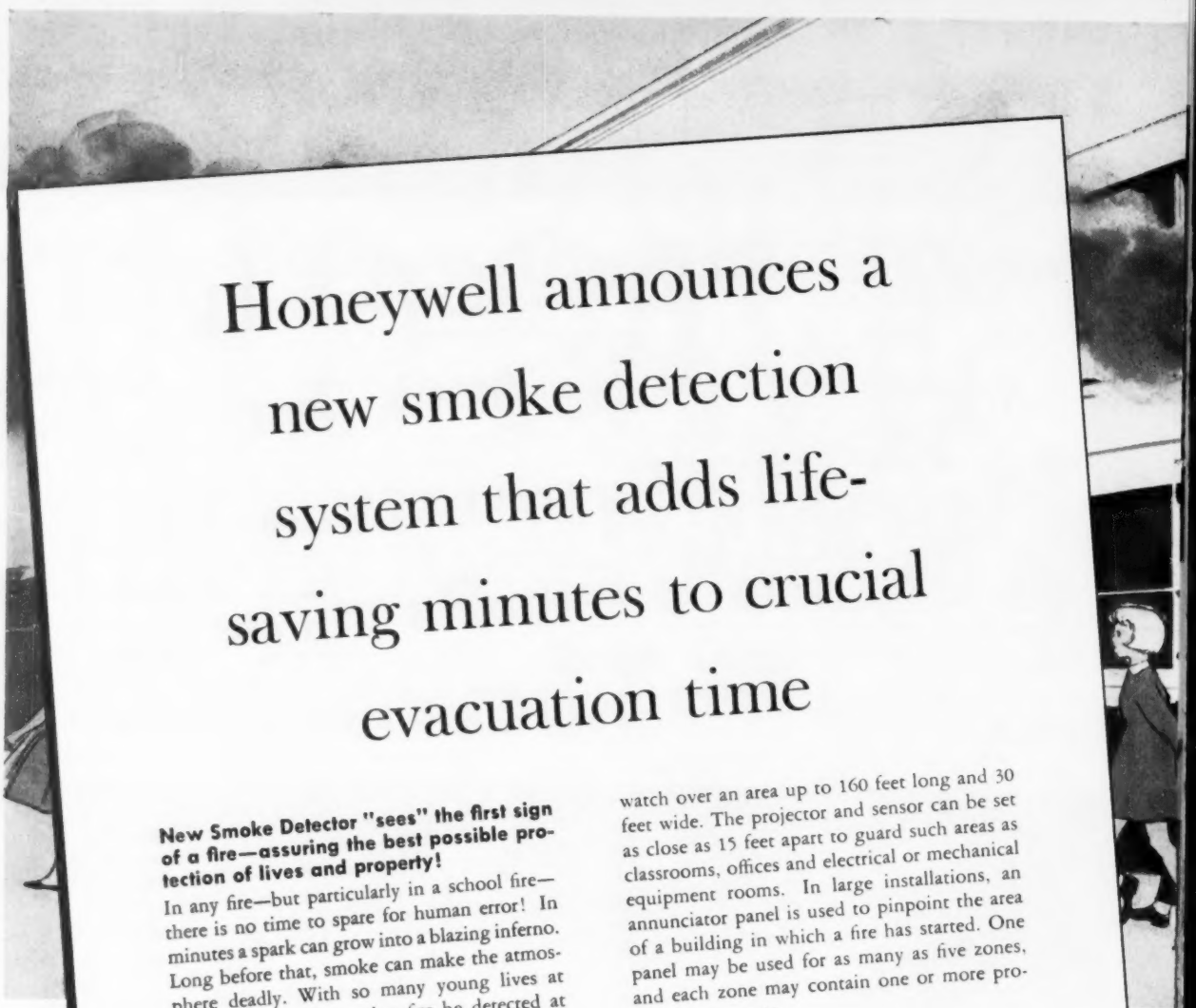
ALCOA
ROME CABLE
DIVISION

ROME SYNTHINOL BUILDING WIRE

TYPE TW – 600 VOLTS

Underwriters' Approved

COPPER			ALUMINUM			SAVINGS	
SIZE	NO. OF STRANDS	LIST PRICE	SIZE	NO. OF STRANDS	LIST PRICE	DOLLARS	PERCENTAGE (Approx.)
6	7	$ 67.30	4	7	$ 54.10	$ 13.20	20%
2	7	137.00	1/0	19	109.00	28.00	20%
4/0	19	406.00	300 MCM	19	311.00	95.00	23%
500 MCM	37	948.00	750 MCM	61	729.00	219.00	23%



Honeywell announces a new smoke detection system that adds life-saving minutes to crucial evacuation time

New Smoke Detector "sees" the first sign of a fire—assuring the best possible protection of lives and property!

In any fire—but particularly in a school fire—there is no time to spare for human error! In minutes a spark can grow into a blazing inferno. Long before that, smoke can make the atmosphere deadly. With so many young lives at stake, it is important that fire be detected at the earliest possible moment.

Now Honeywell has developed a new smoke detection system that *sees* the first sign of a fire—smoke—first. It saves valuable minutes. And these minutes saved can mean lives and property saved.

Compare, and you'll find Honeywell's new Smoke Sentry the fastest detection system available. It stands guard over large, open areas with a constant beam of light. When smoke interrupts this beam, an alarm sounds instantly. Even the tiniest wisp of smoke from a hidden fire will be *seen* and will trigger the alarm mechanism.

Never before, a smoke detector that safeguards an area the size of a basketball court—round-the-clock!

A single Smoke Sentry projector-sensor set will watch over an area up to 160 feet long and 30 feet wide. The projector and sensor can be set as close as 15 feet apart to guard such areas as classrooms, offices and electrical or mechanical equipment rooms. In large installations, an annunciator panel is used to pinpoint the area of a building in which a fire has started. One panel may be used for as many as five zones, and each zone may contain one or more projector-sensor sets.

It's the latest addition to Honeywell's complete fire alarm system for every building, every situation!

The Smoke Sentry can be used in addition to Honeywell's Fire Detection and Alarm System for total protection in critical areas. The combined systems offer four-way safety: fast automatic detection—manual stations—local alarm—and automatic calling of the fire department. For further information about the new Smoke Sentry, call your local Honeywell office. Or write Honeywell, Minneapolis 8, Minnesota. In Canada, write Honeywell Controls, Limited, Toronto 17, Ontario.

NEW RAY-OF-LIGHT SMOKE DETECTOR
PROVIDES EXTRA LIFE-SAVING MINUTES

HONEYWELL INTERNATIONAL
Sales and service offices in all principal cities of the world.
Manufacturing in the United States, United Kingdom,
Canada, Netherlands, Germany, France, Japan.

Honeywell

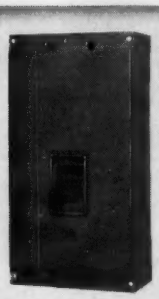
First in Control

SINCE 1885

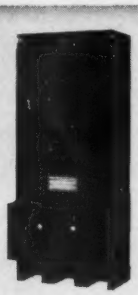
Westinghouse
AB De-ion breaker
selector
To use: Rotate the top disc until the desired
information is obtained. Remember the col-
ored area on the top disc should be matched
to the colored section of the bottom disc to
show physical characteristics. The white area
shows electrical characteristics. For any given
breaker, the electrical characteristics are
directly opposite the physical characteristics
on the selector.
Westinghouse Electric Corporation, Standard
Control Division, Beaver, Pennsylvania
Interrupting Rating (Asym) 240 volts
Max. Amps
400
600
Max. Volts
Interrupting Rating (Sym) 240
a-c 480
a-c 600
DC
22,000
30,000
42,000
20,000
25,000
35,000
50,000
a-c 480
a-c 600
DC
Depth
Width
Height
Replaces
Poles
4⅛
6¼
10¾
8¼
10¾
KL & JKL
2
3
JA
KA
LA
MA
FA
E
MA
LA
KA
JA
FA
E

GOOD DEAL ON A WHEEL

This selector wheel makes it easy for you to identify and specify the world's newest and most complete line of circuit breakers. Get one free from your Westinghouse representative or write to Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. You can be sure . . . if it's Westinghouse



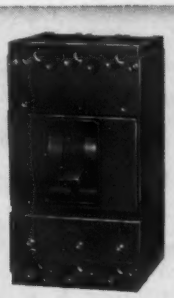
MARK 75* . . . interrupts up to 75,000 amps at 240 volts a-c, and costs only a fraction of conventional high interrupting capacity breakers. Excellent for network systems.



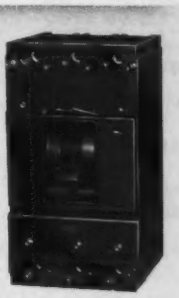
TRI-PAC* . . . smallest, lowest cost protective device you can apply where 100,000 amps can be poured into faults—e.g., network or large transformer-fed systems.

SAF-T-VUE* . . . lets you see whether the contacts are open or closed. Fills the needs of every industrial plant where safety codes require visible contacts. All frame sizes.

AMBIENT COMPENSATED . . . ends nuisance tripping, and eliminates need for derating where elevated or changing temperatures are encountered. All frame sizes.



MAGNETIC ONLY . . . provides short circuit protection only. Primarily used on motor circuits where overload protection is provided by other means. All frames but E.



THERMAL MAGNETIC . . . provides instantaneous opening on short circuits. On sustained overload, the higher the current the shorter the opening time. All frames.

*Trademarks

J-30329

Take the SURGE out of mercury-lamp starting

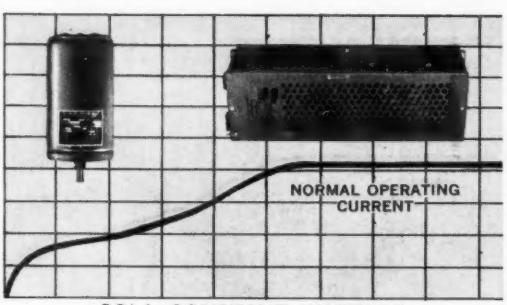
WITH SOLA CONSTANT-WATTAGE BALLASTS

Full rated lamp life . . . more lamps per circuit . . . less costly wiring: These across-the-board SOLA savings reduce installation costs, assure longer lamp life expectancy and less maintenance. And all are direct results of SOLA constant-wattage mercury-lamp ballast design!

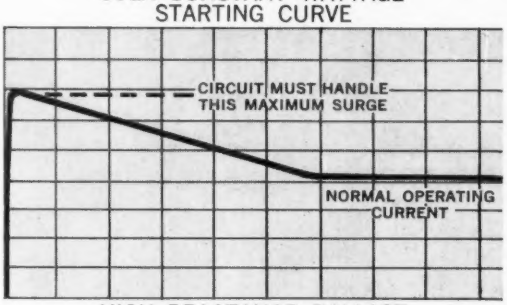
Self-limiting action of constant wattage ballasts takes power-surges out of lamp starting, automatically compensates for line fluctuations. Parallel 2-lamp models operate lamps independently of each other and keep good lamp shining steadily even after mate burns out. Complete range of types for indoor as well as outdoor applications.

SOLA *constant-wattage* holds lumen output within ±1% for line-voltage changes as great as ±13%. "Drop-out" is virtually nil, since input voltage must fall *30% below nominal* before lamp extinguishes. SOLA M-L ballasts are also inherently self-protecting against open and shorted lamps.

Available for 115, 208, 230, 277, 460 and 575-volt input. Get full details from your SOLA supplier, or write us for information, specifying M-L indoor or outdoor type ballast.



SOLA CONSTANT WATTAGE STARTING CURVE



HIGH-REACTANCE BALLAST STARTING CURVE

SOLA

A DIVISION OF BPC BASIC PRODUCTS CORPORATION

SOLA ELECTRIC CO.
1717 Busse Road
Elk Grove Village, Ill.
HEmpstead 9-2800
IN CANADA, Sola-Basic Products Ltd., 377 Evans Ave., Toronto 18, Ontario

S-34-61

WIREMOLD® ELECTRIC IDEAS

PREPARED EACH MONTH FOR ELECTRICAL CONSTRUCTION AND MAINTENANCE TO BRING IDEAS, NEWS AND HELPFUL INFORMATION TO ELECTRICAL MEN

62nd YEAR

OCTOBER 1961

Raceways Add Flexibility When Wiring For Lighting

Surface systems provide simple method of wiring to lighting fixtures in both new and existing buildings

Today, virtually no one questions the need and value of proper lighting in both homes and non-residential buildings.

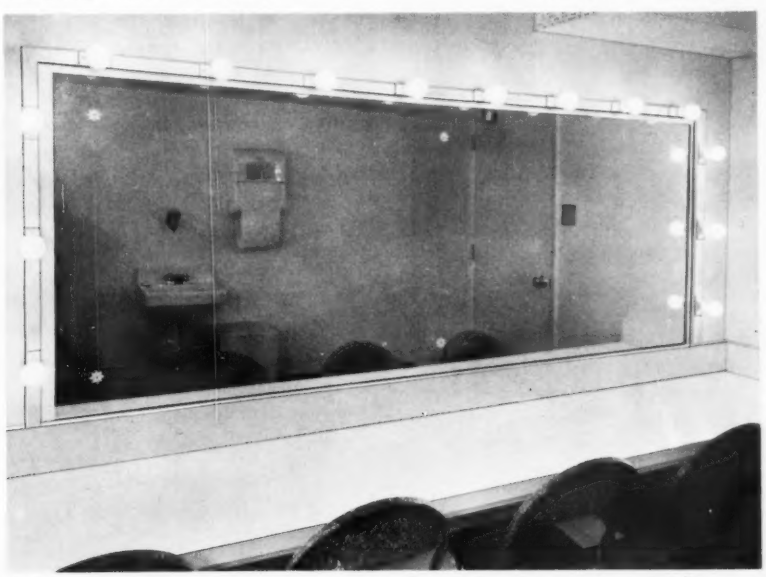
With ever-increasing frequency, engineers and contractors are calling on surface metal raceways for branch lighting circuits.

Surface raceways provide a system which, once installed, assures accessibility for future expansion and, in existing structures, eliminates the need for extensive wall or ceiling breaking while it affords a simple method of bringing in new circuits for lighting or tapping into existing circuits.

Again, raceways are designed so that they are easily shaped to conform to the surface to which they are to be attached. And, when painted, Wiremold blends with the decor of the surface.

For example, in re-wiring a complex of five, multi-storied school

continued on third page



ABILITY of two-piece raceways to accept devices as well as to house conductors is shown in this application for lighting a theatrical make-up mirror. In this case, the devices are of Wiremold design. Other series accept standard devices.

Code Comments

General Lighting Load

Q. *What is the basis for calculating the expected branch circuit general lighting load?*

A. Article 220, Section 220-2(a)(1) states ". . . In the occupancies listed in Table 220-2(a), a load of not less than the unit load specified shall be included for each square foot of floor area.

"In determining the load on the 'watts per square foot' basis, the floor area shall be computed from the outside dimensions of the building, apartment or area involved, and the number of floors; not including open porches, garages in connection with dwelling occupancies, nor unfinished spaces and unused spaces in dwellings unless adaptable for future use.

"The unit values herein are based on minimum load conditions and 100 per cent power factor, and may not provide sufficient capacity for the installation contemplated.

"In view of the trend toward higher intensity lighting systems and increased loads due to more general use of fixed and portable appliances, each installation should be considered as to the load likely to be imposed and the capacity increased to insure safe operation.

"Where electric discharge lighting systems are to be installed, high power-factor type should be used or the conductor capacity may need to be increased."

Number of Conductors

Q. *How many conductors may be installed in surface metal raceways?*

A. Section 352-4, Article 352 states: "The number of conductors installed in any raceway shall be no greater than the number for which it is designed."

WIREMOLD®

Advertisement

Editorial

Provide enough at the start

That contractors are throwing away, either willingly or otherwise, more than $70,000,000 a year is perhaps unimportant if it were not endangering the safety of their customers.

Statistically, the figure is not only unassailable — it's ultra-conservative. The figure represents the amount of money — out of a far larger sum — which is lost to contractors when homeowners buy extension cords and cube taps to make up for the outlets that were not put into their homes.

With every survey indicating the importance home buyers place on electric wiring, it is imperative that the specifier, when planning for outlets, provide sufficient receptacles to meet present and future needs. Perhaps the simplest way to do this is to use Plugmold® systems at the outset.

Product of the Month

Canopy cutter simplifies cutting opening for wiring fluorescent fixtures

A simple method of cutting any fluorescent fixture canopy to take Wiremold 500 or 700 is to use the 657 Canopy Cutter.

With this powerful, heavy-duty tool it takes only a moment to cut accurate, standard openings in the canopy. Shaped and used like a pair of pliers, the 657 has a size gauge for 500 or 700 raceway. Simply set the gauge and cut through the fixture canopy with maximum efficiency and minimum effort.

Use of the tool eliminates the tedious and haphazard cutting of canopies with snips or hacksaw.

Quiz Corner

Questions for this department are taken from inquiries received from the field. Your questions are welcome; indeed, they are necessary if this department is to serve you with worthwhile information. Address: Quiz Corner, The Wiremold Company, Hartford 10, Conn.

Q. *If I need some special sections or lengths of Plugmold, what quantity do I have to order to have the factory make them up?*

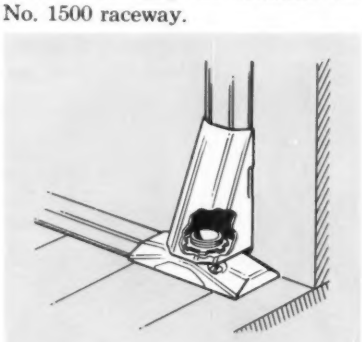
A. Quantity, of course, governs the price. Tell us what the quantity is and price and delivery information will be furnished.

Q. *On a laboratory job where I have numerous lengths of 3000 with receptacles on 24" centers, can the factory furnish these to me in the exact length, all wired?*

A. Yes. This comes under the heading of an Engineered Special. Send us your specifications and we will be glad to quote.

Q. *How does one connect 1500 raceway on the wall to 1500 raceway on the floor at right angles?*

A. With the combination of No. 1528 Utility Box and No. 1585 Combination Connector, a twisted elbow effect may be obtained for No. 1500 raceway.



Ground to Ground

Each month we ask a question which, when answered, will help us improve our products and services to you. A frank answer will be appreciated. Answers will not be published, but will be acknowledged. Address:

Ground to Ground
The Wiremold Company
Hartford 10, Conn.

One of the most frequent topics of conversation among contractors is in-field improvisation. What, in your opinion, is the greatest repeated cause of improvisation on the job? Is it lack of fittings in the manufacturer's line? Is it due to the distributor's failing to stock a complete line? Or, is it failure to anticipate job requirements?

WIREMOLD®

WIREMOLD ■ HARTFORD 10, CONN. E1-10

Gentlemen: Please send me checked items

NAME _____

COMPANY _____

ADDRESS _____

- ☐ Building Manual reprint
- ☐ Furniture Retailer reprint
- ☐ Housepower Use-Planner
- ☐ Electric Ideas, September 1961
- ☐ Electric Ideas, August 1961
- ☐ Wiring Guide (Catalog 22)

Raceways Add Flexibility *continued from first page*

ABILITY TO CONFORM to ceiling contour was important in planning wiring for lighting in this remodeled school.

SURFACE SYSTEM, with Swivelier fixtures, provides dramatic, flexible means of illuminating furniture display in this store.

buildings — averaging about 40 years old and of masonry and plank-and-beam construction — Wiremold was specified because of the need for economy and speed of installation and because of the physical aspects of the buildings.

According to the contractor, "Wiremold was selected because the completeness of its line — raceways, devices, fittings, and the like — assured us of in-the-field flexibility not immediately available with other systems."

Another advantage cited was the fact that the raceways were of one-piece construction. This permits the electrician to fish his wires through, rather than having to hold them while clamping a cover in place.

In this job, an 800-amp. service was installed in the main building, located across the street from the rest of the complex. The trade school has an individual 1000-amp. service, and the rest of the complex is serviced from a 1200-amp. panel.

Raceway was used to feed general lighting, emergency lighting, and to supply power for classrooms and offices. Fluorescent lighting with a maintained level of 30-40 foot candles was installed throughout, with the exception of washrooms and corridors where incandescent lighting was used.

In those cases where it is desirable to place devices directly within the raceway, a complete line of two-piece raceways is available. Depending upon the series selected, either standard or Wiremold-designed devices may be used.

In addition, the two-piece systems feature larger capacity — up to 40 No. 12s for the largest.

LIGHTING branch circuits in this drafting room were simplified when Wiremold was specified. The 2100 series raceway is mounted on a wooden strip on ceiling.

Personnel Notes

NECA's annual exposition will put Vic Barringer, Washington, Tom Pugh, Baltimore, and Bill Ball and Sam Page, home office, on tap as hosts in Washington.

Harold Short, Charlotte, N.C., will handle Wiremold honors in Asheville, while Charlie Wirtz will do the same at the Cincinnati show and Ed Love at the Pittsburgh exposition.

Show dates and locations are listed under "Meetings Ahead."

Vic Barringer

Tom Pugh

Bill Ball

Sam Page

Charlie Wirtz

Ed Love

Meetings Ahead

NECA Annual Electrical Exposition — Sheraton Park Hotel, Washington, D. C., Oct. 10-13.

Southern Section, I. A. E. I. — Grove Park Inn, Asheville, N. C., Oct. 15-18.

Electricity for Industry Show — Hartwell Recreation Center, Cincinnati, Ohio, Oct. 17-19.

Industrial Electric Exposition (Electric League of Western Pennsylvania) — Penn-Sheraton Hotel, Pittsburgh, Pa., Nov. 7-9.

WIREMOLD®

Engineered Specials

Special 3001B Coupling developed as cable hanger

PROBLEM:

To provide a method of suspending Wiremold 3000, used as a raceway for branch lighting circuits over an 80-ft. span, when structure is of truss construction.

SOLUTION:

A standard Wiremold 3001B Rigid Outside Coupling was modified to permit passing a ⅜-in. messenger cable through, eliminating any possibility of sway and adding support to the raceway.

DISCUSSION:

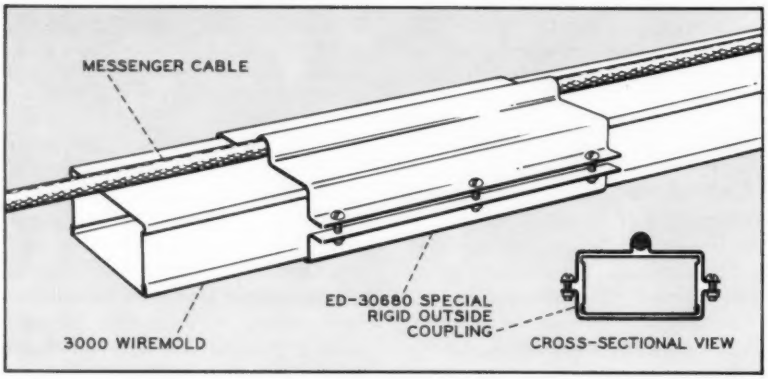
A new building, with an arched ceiling 60-ft. high at its center, required a light level of 97 foot-candles at working height.

It was decided to use multiple runs of Wiremold 3000 for the conductor housing, with 3001B couplings for added strength between sections. Luminaires were to be a combination of 9 incandescent and 54 mercury vapor lamps, suspended at truss height from the raceway.

The 3001B was modified so that an offset was provided for the cable to pass through. Raceway sections were joined together and wired on the floor, then hoisted to the trusses by means of hand lines. Fixtures were supported from the raceway by means of a special 3046HX plate.

According to the contractor, the use of raceway proved more economical than had he used conduit and conventional installation techniques.

Wiremold engineers are pleased to develop new, or modify existing, products to aid in the solution of in-field problems.



Worth Reading

Check coupon on preceding page for copies of listed items.

Electric Outlets: How Many and Where?, House Beautiful's Building Manual, Fall-Winter issue, 1961. Describes a simple method for the homeowner to judge how many outlets will be needed and where they should be placed; emphasizes need for plenty of conveniently placed receptacles. Contains comprehensive list of portable electric appliances with typical wattage for each. Article is based on Wiremold's "Housepower Use-Planner".

Colonial Furnishings, Furniture Retailer, July, 1961. A description of the remodeling and rewiring of an old parsonage for a modern furniture store. Points out how use of Plugmold provided for proper display of furnishing.

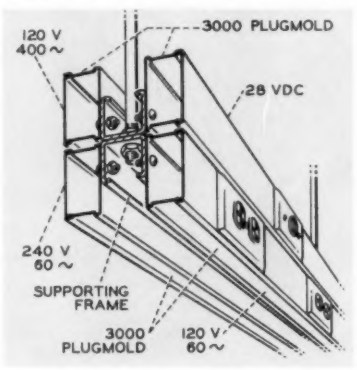
Practical Tips

Ganging multiple runs of Wiremold 3000 provides variety of services with plenty of outlets

When a variety of adjacent electrical services is required, with plenty of outlets for each type, a practical approach is to gang multiple runs of Wiremold 3000 on a single supporting frame.

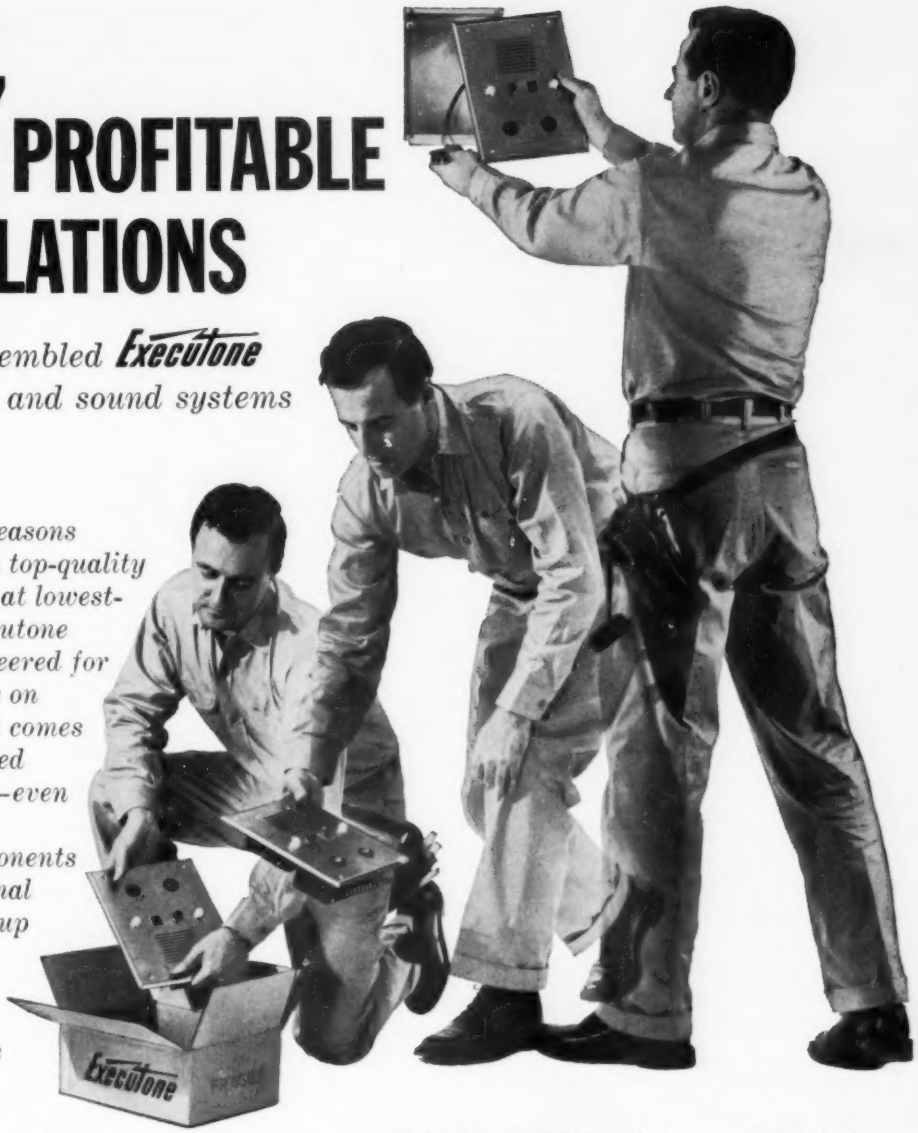
Depending upon the ceiling construction, the frame may be suspended at the desired height from the ceiling by 1-in. pipe. Guy wires may be used to avoid sway.

In one typical case, four runs of Wiremold 3000 were bolted to the supporting frame to provide the following services: 28-v. DC; 120 v., 60 cycle; 240-v., 60 cycle, single phase; and 120-v., 400 cycle, 3-phase. In other cases, this concept was used for service up to 240-v., 400 cycle.



FASTER, MORE PROFITABLE INSTALLATIONS

with factory-assembled **Executone** *intercom and sound systems*



Here's one of five reasons why you can put in top-quality Executone systems at lowest-installed-cost. Executone equipment is engineered for least assembly time on the job. Every unit comes completely assembled and factory-tested—even consoles, racks and reproducers. Components have plug-in terminal blocks, to cut hook-up time to a bare minimum. Check these other profit-building Executone Extras:

- **EXPERT PRE-PLANNING:** assistance in system layout, preparation of bids and estimates.
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- **COMPLETELY ENGINEERED SYSTEMS** from one source—even including special color-coded wire.
- **NO SERVICE CALL-BACKS** because Executone takes full, immediate responsibility for operation of the system.

Start building profits the Executone way. Check the coupon below for information on Executone sound and communication equipment for selected building types. We'll also send you a convenient Conduit Selection Chart to help you cut costs in layout and installation.

Executone
COMMUNICATION AND SOUND SYSTEMS

Executone, Inc., 415 Lexington Ave., Dept. G-10, New York 17, N. Y.

Send me your Conduit, Wire and Cable Chart. Also: information on Executone equipment for

☐ schools ☐ hospitals ☐ offices ☐ plants ☐ retail stores ☐ homes ☐ other_____

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Company_____

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City_____ Zone_____ State_____

In Canada: 331 Bartlett Avenue, Toronto

Only new Lumi-Flo air handling Troffers offer all these advantages

Benjamin has forged far ahead of the field with this latest advance in combination lighting and air handling fixtures.

These improvements are basic; it is to your advantage to give yourself the security of a thorough investigation before a final decision is made.

CLEAN CEILINGS WITH COMPLETE FLEXIBILITY

With Lumi-Flo you can be assured of ceilings which are esthetically clean without any visible ceiling obstructions. All you see is an attractive, well illuminated ceiling. With the new Benjamin Triple-Shell Lumi-Flo, you can light, cool, heat and ventilate interior areas through the same concealed troffer. When it comes to flexibility, Lumi-Flo can't be topped—you can design your building so that every 25 or 250 sq. ft. of floor area has its own air conditioning and ventilating. Better yet, when your requirements vary, you can have both in the same installation.

OFFERS MAXIMUM LIGHT EFFICIENCY

With Triple-Shell Lumi-Flo, the air supply is separated from the lamp chamber by an insulating air gap. Used on cooling or heating cycle, Triple-Shell construction permits heat dissipation to the plenum, yet prevents lamp chamber from over-cooling (which causes "pink-light") or over-heating (which reduces lamp efficiency).

Lumi-Flo offers the highest average operating efficiency possible through the normal cooling and heating ranges.

Lamp flicker and color variation caused by over-cooling are things of the past with Triple-Shell Lumi-Flo.

AN AIR CAPACITY TO MEET EVERY JOB CONDITION

With Triple-Shell Lumi-Flo, you can meet the exact requirements of any job, large or small. Two types of dampers engineered by Tuttle & Bailey give air-handling capacities from zero to over 200 CFM and combine with two basic air patterns to offer the best possible combination of capacity and distribution for your specific application.

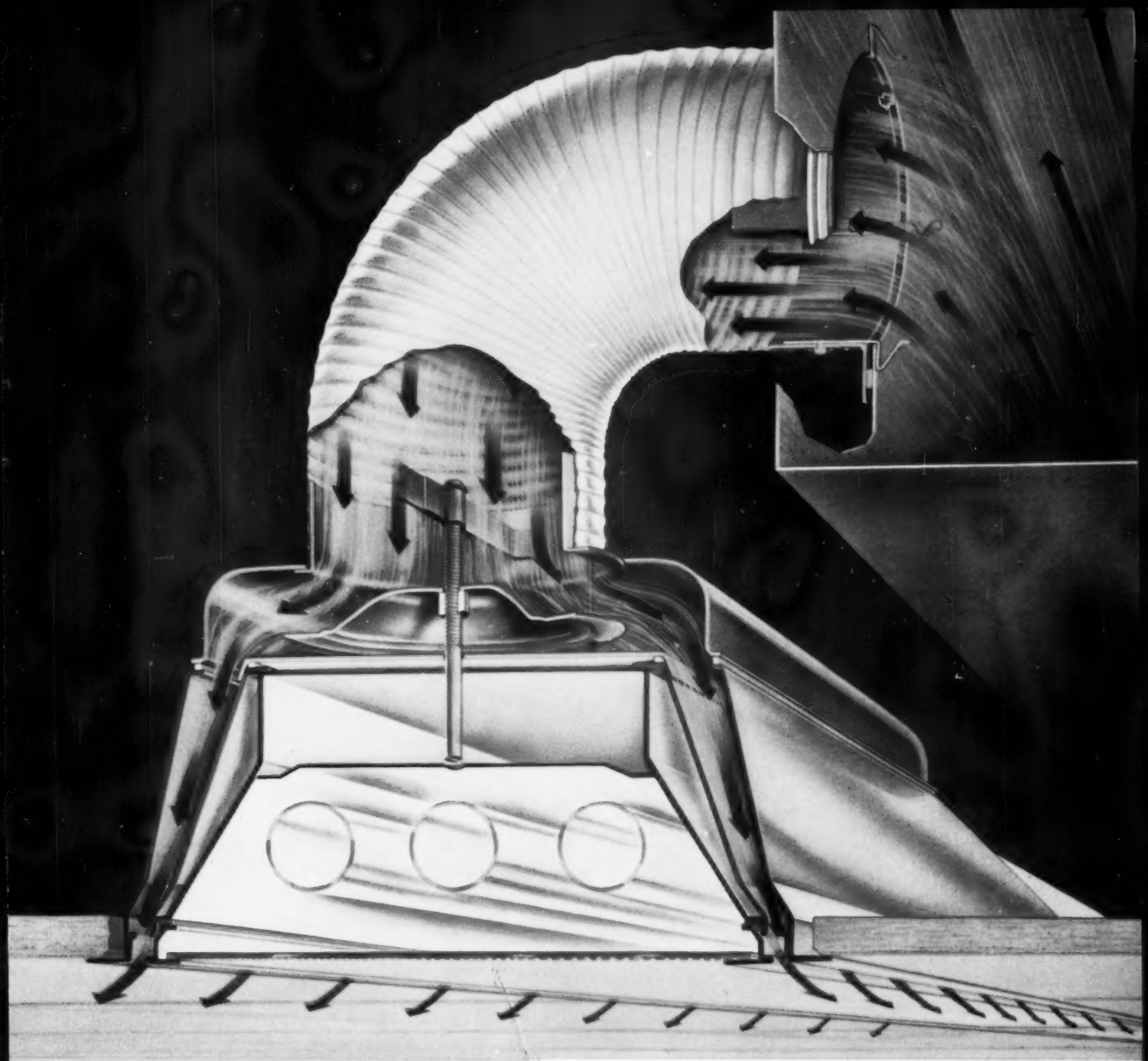
FASTER, MORE ECONOMICAL INSTALLATION

No cumbersome yokes—a swivel bar hanging device cuts installation time as much as 50%. Damper installation is simple and quick—one snap and a special locking device makes the damper a permanent part of the troffer. Special neoprene gasketing eliminates the possibility of air leaks.

DAMPERS ARE QUIET, EASILY ADJUSTABLE

Dampers are engineered by Tuttle & Bailey for quiet operation at all capacities. The dampers adjust quickly, easily—give precise adjustment over wide pressure ranges. Balancing is simplified.

Lumi-Flo is the only complete line listed by Underwriters' Laboratories for lighting, cooling and heating.



▲ Here is a cutaway view of the new Benjamin Triple-Shell Lumi-Flo troffer. See how the damper diffuses the air and directs it evenly to air manifolds on both sides of the troffer. Note also how the lamp chamber is separated from the air passageway at top and sides by an insulating air gap. This lets lamps operate at near their optimum design temperature—unaffected by the cooling or heating air flow.

◀ Here's what Triple-Shell Lumi-Flo troffers do for ceilings. The integrated lighting and air conditioning system is totally compatible in function and appearance with the handsome architecture of the Illinois Agricultural Building at Bloomington, Illinois.

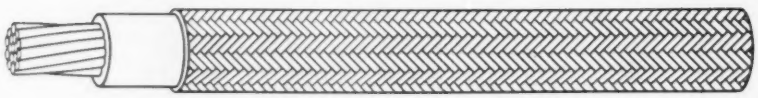
Write today for new, 40 page Lumi-Flo Catalog

The most complete manual on Air-Handling Troffers ever compiled.

BENJAMIN DIVISION
THOMAS INDUSTRIES Inc.
207 EAST BROADWAY
LOUISVILLE 2, KENTUCKY

Air Handling components by Tuttle & Bailey Division of Allied Thermal Corporation, New Britain, Connecticut.

Progress report from COLLYER . . .



Collyer POWER CABLE with SILICONE INSULATION – another progressive contribution to BETTER POWER CABLE for HOT LOCATIONS . . . or for GREATER CURRENT CARRYING CAPACITY . . .

Here is why and how it will help you

Built to take heat

Collyer Power Cable with Silicone Insulation has remarkable heat resistance. Because silicone is a thermosetting material, it provides a homogeneous, non-hygroscopic, flexible, and elastic insulating wall over the conductors. The physical and electrical properties of this cable are unimpaired when operated in a continuous ambient temperature of 150°C . . . and these properties suffer no ill effects even with intermittent rises in ambient temperature to 200°C. This power cable's insulation feels like rubber — works like rubber — yet it provides longer and more satisfactory service life than rubber in hot locations.

Excellent ozone resistance

In addition to its heat resistance Collyer Power Cable with Silicone Insulation affords superior ozone resistance. This cable, then, is excellent for handling high voltages in hot locations.

Durable . . . workable

Although the insulation will burn when a flame is applied directly to it, Collyer Power Cable with Silicone Insulation will not support combustion. Should the insulation be burned by the direct application of flame, the remaining ash which will be held in place by the glass or asbestos braid, has insulating properties, and the cable will still be serviceable on a temporary basis. Standard methods are used to install Collyer Silicone Power Cable. No kid-glove treatment is necessary. The insulation is tough and will withstand normal handling during installation.

A variety of constructions

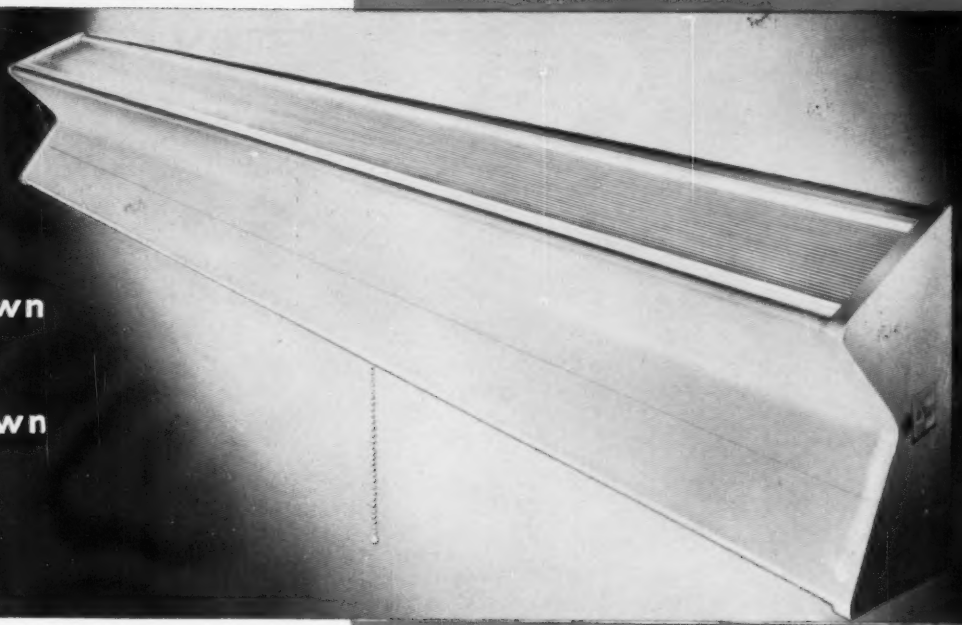
Collyer Power Cables with Silicone Insulation are available in single or completely color coded multi-conductor cables with overall coverings of glass, glass and asbestos, or asbestos braids, or interlocked armor of galvanized steel or aluminum.

For more information ask your Collyer Distributor, Agent or write for Specification Data Sheets P-150 and P-151 to COLLYER INSULATED WIRE CO., 265 ROOSEVELT AVE., PAWTUCKET, RHODE ISLAND.

Collyer Cables

miller

MULTI-PURPOSE WALL LIGHT



- Lights Down
- Lights Up and Down
- Lights Up

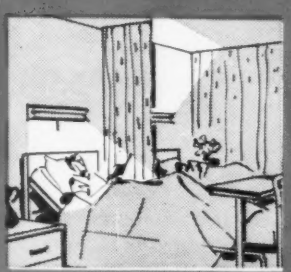
Here's a new fluorescent fixture that offers the ideal solution to many special, wall mounting lighting applications. Switched units provide a choice of *up-light*, *down-light* or both *up* and *down* light depending on the lighting need.

When *up-light* and *down-light* are used together, you get a desirable balance of direct light for reading, writing or working, with soft, comfortable general room illumination.

Ideal for lighting the areas illustrated—as well as for private offices, lounges, apparel fitting rooms and similar locations. Equally desirable for new buildings or modernization of older areas. Comes in 2, 3 and 4 foot lengths for individual or continuous wall mounting.

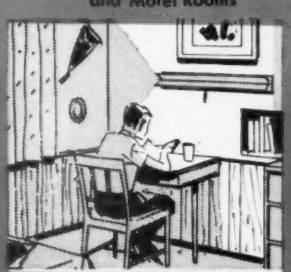
Premium quality *acrylic refractors at no premium in price*, softly diffuse the light—will never discolor. All switched units are equipped with a convenient, built-in electric outlet. A built-in night light is optional. Easy to relamp and clean.

For complete catalog information, write Department 1061 or contact your Miller Representative.

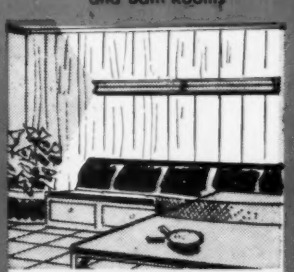


Hospital Beds and Motel Rooms

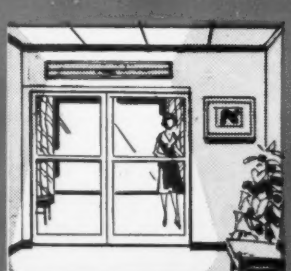
Wash Rooms and Bath Rooms



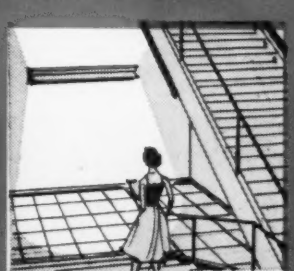
Home Study Areas



Recreation Rooms



Entryways



Stairwells

LIGHTING BY miller SINCE 1844

THE **miller** COMPANY
MERIDEN, CONNECTICUT • UTICA, OHIO

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Miller Booth 117
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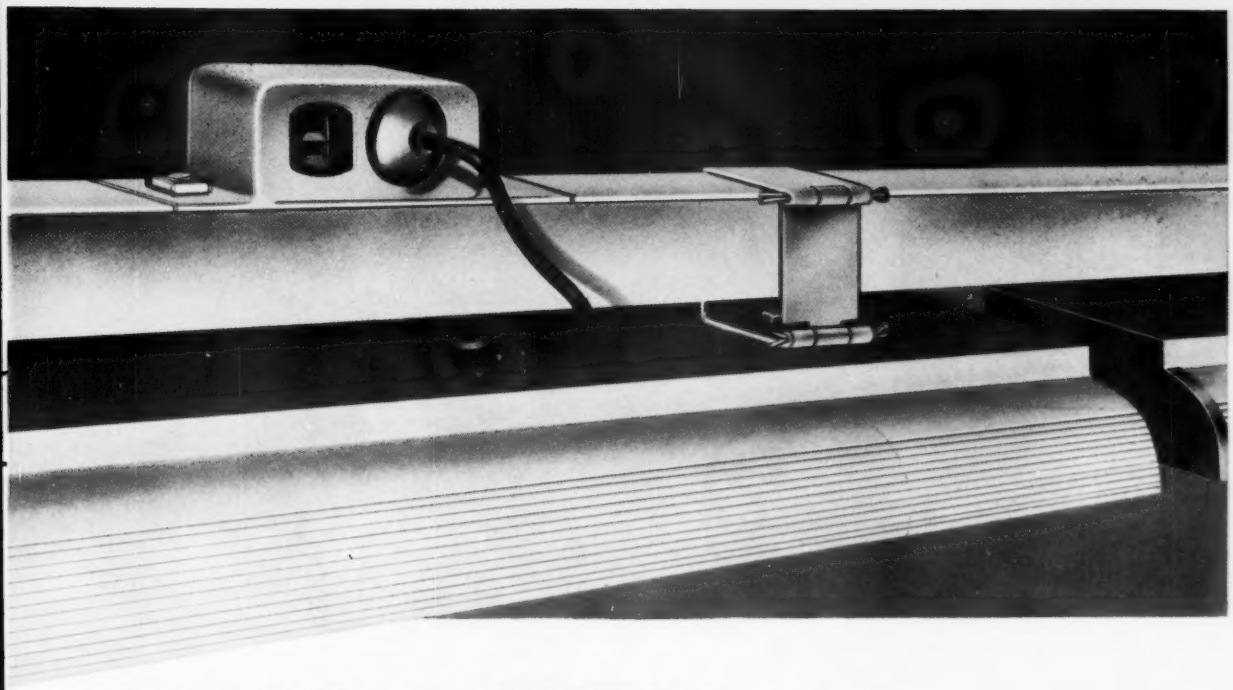

HANGS & FEEDS the fixtures
OR SUSPENDED LIGHTING

SURFACE RACEWAY SYSTEMS
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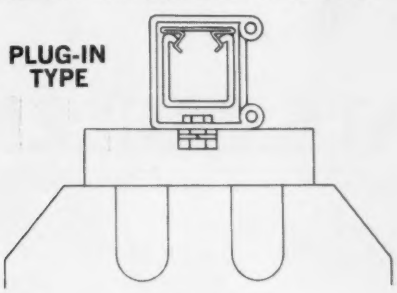
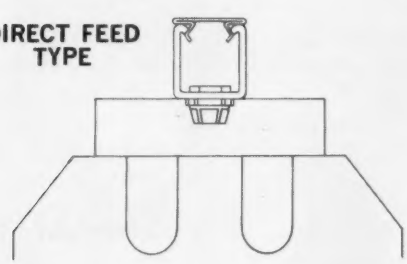
FIXTURE ATTACHMENT METHODS

PLUG-IN TYPE



DIRECT FEED TYPE



STEEL CITY CHANNELS

Channels of various depths and gauges, for use as surface raceway wiring systems or for fixture support only, are available as standard.

When used as a raceway, the Channel capacities are more than ample for every lighting requirement—up to ten No. 8 AWG conductors (National Electrical Code).

Steel City Channels and accessory fittings are protected by the GALV-KROM finish—an electrogalvanized finish PLUS added protection of zinc chromate. The GALV-KROM process imparts an attractive bronze lustre to the surface which does not require painting.

Steel City Electric Co.
Pittsburgh 33, Pa.

Please send me free booklet G-2.

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Company _____

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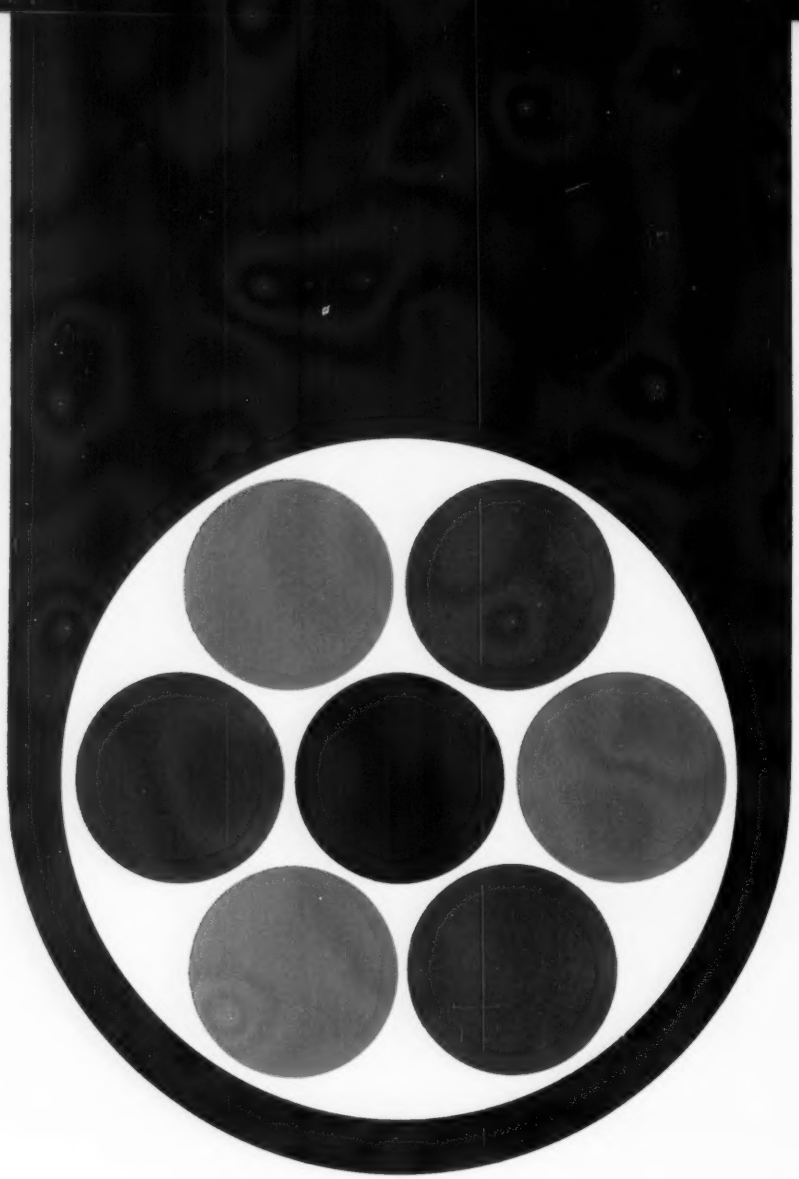


NEW WAY TO EVALUATE CABLE!

"VALUE RATINGS" RELATE PERFORMANCE TO IPCEA OR COMPETITIVE STANDARDS

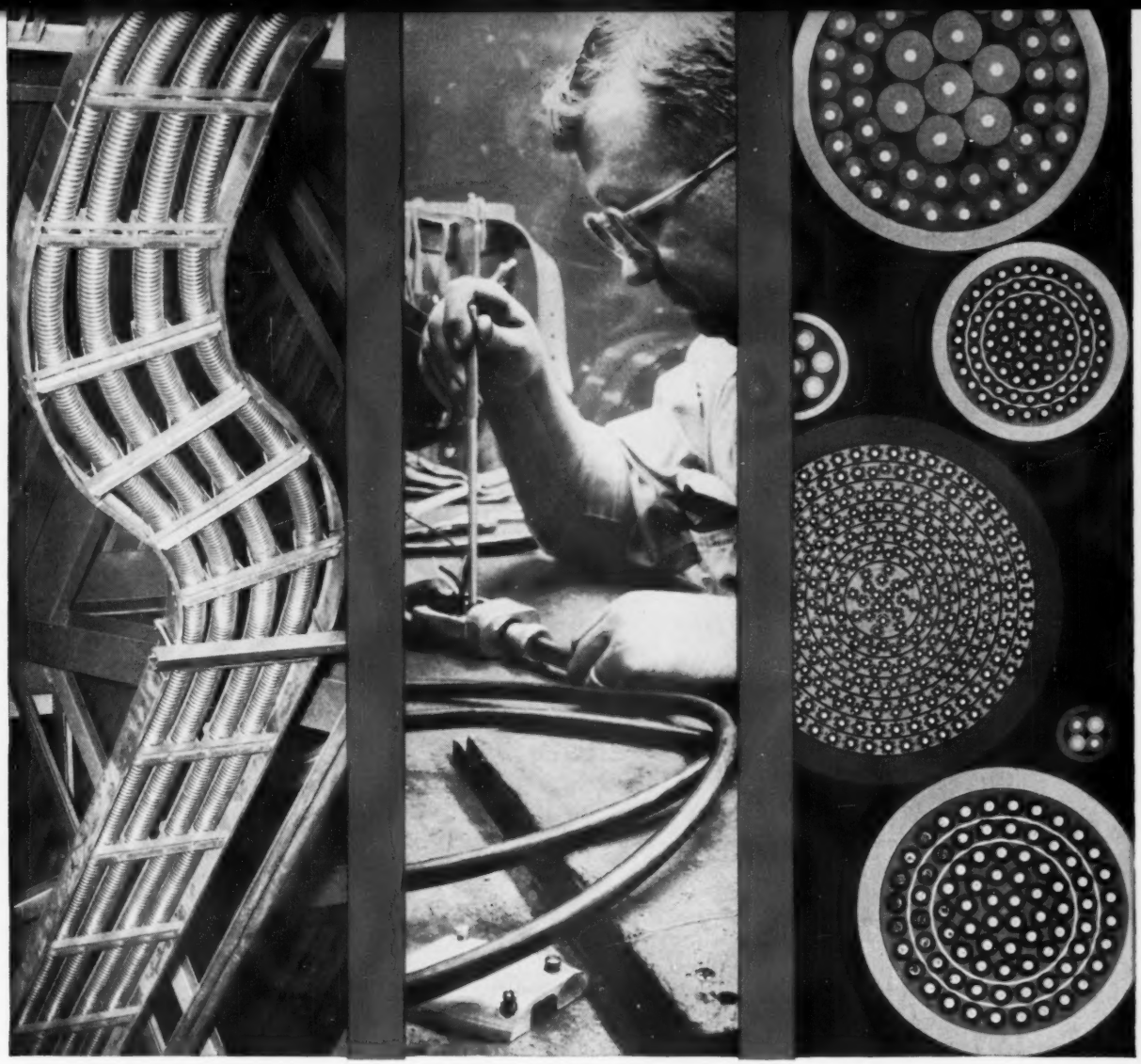
New Value Ratings tell at a glance the composite story of each Kaiser Wire construction—as it performed in as many as 25 specified tests. In each case a well-known standard serves as 100%:

For power cable, the Value Rating standard is all IPCEA test requirements for types of insulation and jacketing specified . . . For portable cord, the standard is service-per-dollar for the least expensive cord (C.V.) as proved by life-expectancy tests. . . . For control cable, the standard is a composite of minimum requirements for eight important insulation qualities.

Compared to these standards, Kaiser Wire constructions earn Value Ratings as large as 767%—valid proof that the spark of quality is Kaiser Wire experience.

For details and Value Rating listings, ask your Kaiser Wire Distributor for free K/W Value Rating Bulletins, or write: Kaiser Wire, Room 844h, Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, California.

KAISER ALUMINUM & CHEMICAL CORPORATION



KAISER INTERLOCKED ARMOR CABLE DISTRIBUTES POWER AT LOWER COST

It needs no conduit for protection. It is flexible, forms easily. And because of its light weight, K/W Aluminum Interlocked Armor Cable cuts installation costs. One hundred feet of this aluminum-armored cable in unshielded 5KV, 3-cdr, size 1/0 AWG, weighs only 125 lbs. compared to 234 lbs. for size 2, copper-conductor steel-armored. K/W aluminum-armored is corrosion resistant . . . and its insulation has nearly 20 times the ozone resistance required by IPCEA.

K/W ALUMINUM INTERLOCKED ARMOR CABLE
VALUE 363% RATING

KAISER PORTABLE CORD SAVES $22.24 IN ONE TOOL'S REPAIRS

A typical case shows how K/W Master Laytex portable cord can save $22.24 in maintenance—before a single repair. A new length of K/W Master Laytex cost the buyer $4.65; plus an estimated $6.00 labor to connect it. An equal length of "bargain" cord (low-priced C.V.) cost $2.89. But the latter was in and out for repairs five times—running up $30.00 labor—before K/W Master Laytex failed once. The net saving was $22.24 with K/W Master Laytex cord.

K/W MASTER LAYTEX PORTABLE CORD
VALUE 308% RATING

KAISER CONTROL CABLES OFFER WIDEST CHOICE OF INSULATIONS

Kaiser Wire offers the following broad range of control cable insulations . . . Thermoplastics: Polyethylene, Polyvinyl Chloride. Synthetic rubber: Pyrosec® (SBR), Hydrosec® (SBR), Oil base, Kalzone® (butyl), Silicone. Natural rubber: Kaiser Laytex®, the patented liquid latex covering unequalled for strength and dielectric qualities. Add neoprene or plastic jacketing, copper or aluminum conductor—and you can choose from hundreds of K/W cables of extra value!

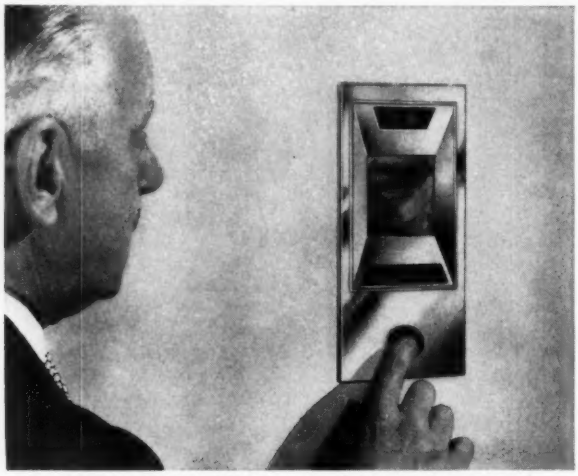
K/W LAYTEX-RESIN CONTROL CABLE
VALUE 767% RATING

IN COPPER AND ALUMINUM CABLES . . . THE SPARK OF QUALITY IS KAISER WIRE EXPERIENCE! KAISER ALUMINUM

VESTIBULE AND LOBBY TELEPHONES, *for communication with apartments, may be combined with mail boxes and alphabetical directories. New, modular design, cordless loudspeaking.*

APARTMENT TELEPHONES, *with new electronically-produced signals, are modern and streamlined. Simple, plug-in construction reduces installation costs, facilitates maintenance.*

"LIFE"-SIZE MAIL BOXES *do not bend or tear full size magazines or other mail because of the full-opening door design. Two-piece construction cuts down installation time, simplifies maintenance.*



NON-ELECTRIC DOOR CHIMES *are completely mechanical and provide lowest cost installation. Models available are: colonial knocker, pushbutton, one-way mirror viewer (illustrated).*

Only Auth Offers A Complete Line of

APARTMENT HOUSE COMMUNICATION EQUIPMENT

More and more architects, contractors and distributors are calling on Auth for apartment house equipment. The reasons? Auth offers the widest selection of apartment house telephone systems, mail boxes and non-electric door chimes available anywhere in the country. This means you can meet all your requirements from one dependable source. And—no matter how extensive or complex the installation, you're assured of identical high quality and efficiency throughout the building.

Most important for cost-conscious builders and contractors, Auth's 70 years of experience in manufacturing communication equipment for apartment house service means that every Auth product is engineered for easy, low cost installation, and minimum maintenance.

Auth "Life"-Size Mail Boxes, Vestibule-to-Apartment Telephone Systems, and Non-Electric Door Chimes pictured above are typical of the quality equipment supplied by Auth for thousands of modern apartment buildings. Many other types and models are included in the Auth catalog to meet virtually every apartment house requirement.

If you are not yet acquainted with Auth apartment house equipment, write for new Auth Catalog Section AM today. A copy is yours for the asking, without obligation.

Auth SINCE 1892

Auth Electric Company, Inc.

LONG ISLAND CITY 1, NEW YORK

MANUFACTURERS OF APARTMENT HOUSE TELEPHONE SYSTEMS, MAIL BOXES, DOOR CHIMES, AND BELL SYSTEMS

WHAT ELSE IS DIFFERENT ABOUT NEW HYPALON® DROP WIRE?

Color is the first thing you'll notice when you see this new multiplex service drop wire covered with HYPALON synthetic rubber. Why color? It can mean easier size and phase identification, simpler warehousing, speedier line identification, accurate hook-ups.

But non-fading color is only one of the many differences you'll find in HYPALON covered drop wire.

HYPALON's resistance to sunlight, weather and ozone is unmatched by any other drop wire covering. Because HYPALON is an elastomer, it resists compression cutting, hot and cold flow . . . remains flexible at low temperatures. What's more, HYPALON is flame resistant. It's a material specifically tailored to meet the needs of drop wire covering.

New HYPALON covered service drop wire is now available in duplex, triplex and quadruplex constructions and in sizes to meet most requirements. For more information about HYPALON and its growing use in other electrical applications, write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department ECM-10, Wilmington 98, Delaware.

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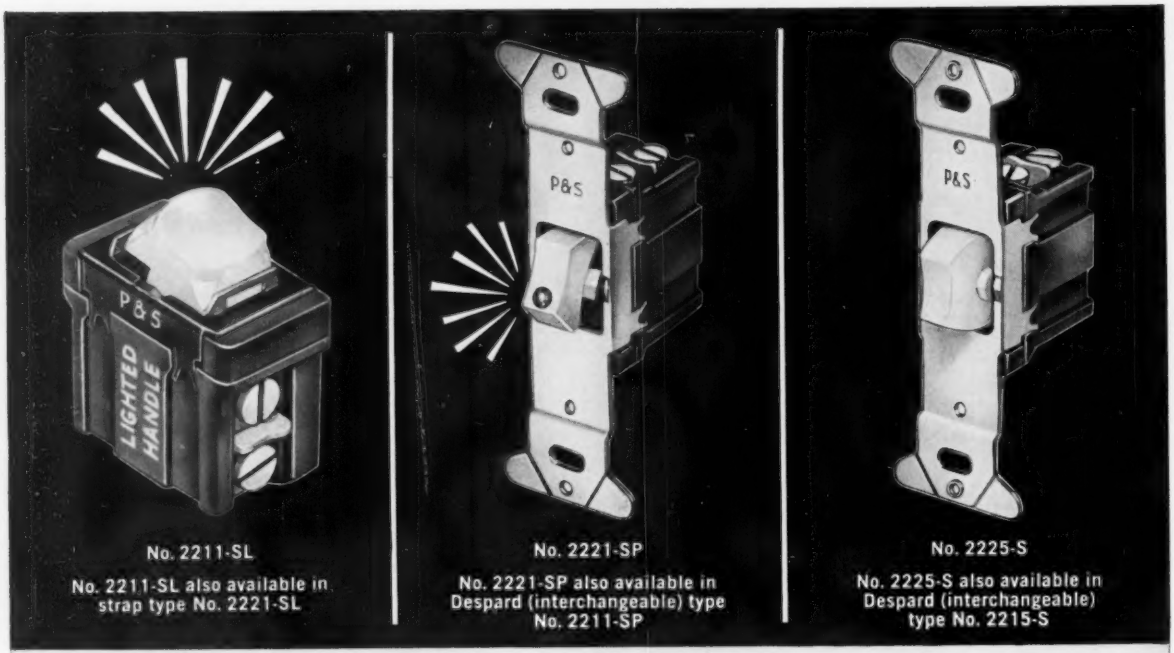
HYPALON®
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

NOW! 3 NEW P&S ROCKER-GLO SWITCHES!



No. 2211-SL

No. 2211-SL also available in strap type No. 2221-SL

No. 2221-SP

No. 2221-SP also available in Despard (interchangeable) type No. 2211-SP

No. 2225-S

No. 2225-S also available in Despard (interchangeable) type No. 2215-S

1

LIGHTED HANDLE ROCKER-GLO

Pinpoints switch location in darkened rooms or hallways. Tiny, long-life neon lamp softly glows in OFF position only. Single pole or three-way. Rating: 15 Amperes, 120 Volts, A.C.

2

Pilot Light HANDLE ROCKER-GLO

Instantly shows when appliances or lights are on. Tiny red plastic jewel in rocker button lights in ON position only. Single pole only. Rating: 15 Amperes, 120 Volts, A.C.

3

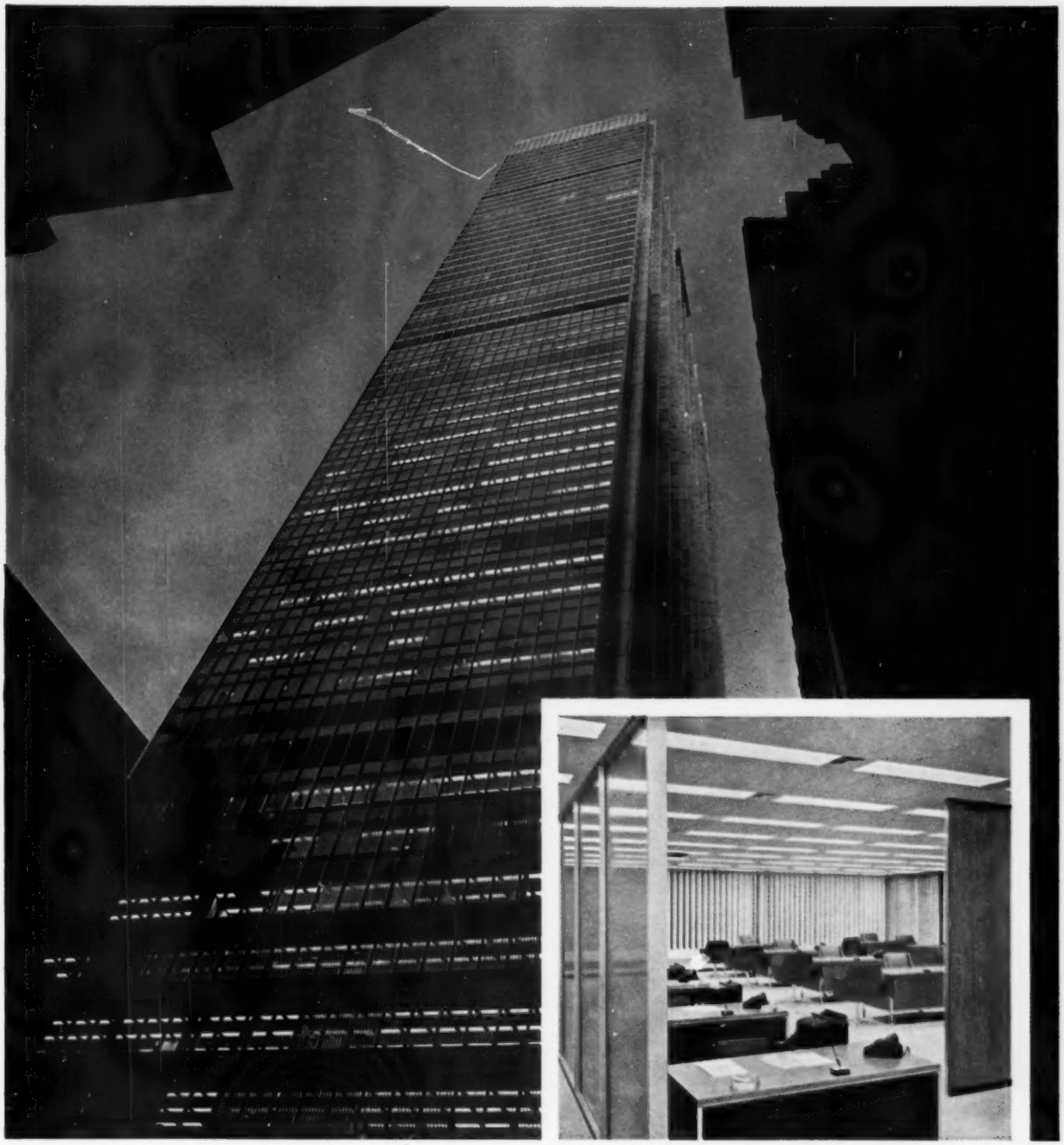
REMOTE CONTROL ROCKER-GLO

Momentary contact, center "off" switch. Designed especially for low voltage remote control applications—controlling large banks of lighting, operating stage curtains, etc. Single pole, double throw. Rating: 10 Amperes, 48 Volts, A.C.

For more information write Dept. ECM1061

P&S PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK

60 E. 42nd St., New York 17, N.Y. 1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario



Architects: Skidmore, Owings & Merrill

Prestige lighting for prestige buildings— Plexiglas

There are 40,000 fluorescent luminaires, each equipped with a lens molded of crystal-clear PLEXIGLAS® acrylic plastic, at the new Chase Manhattan Bank building in New York—a landmark on the downtown skyline and a milestone in architectural planning.

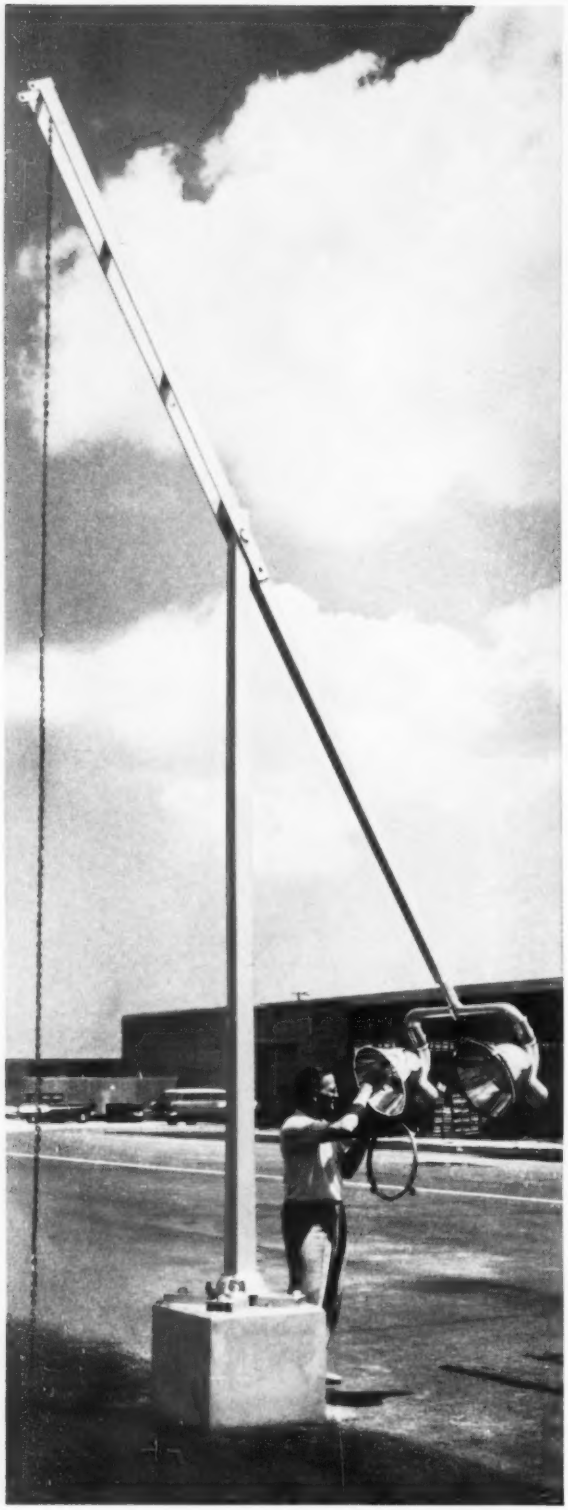
The PLEXIGLAS lenses are precisely designed optical elements that assure full utilization of light. They are strong and rigid, yet light in weight . . . will remain free of discoloration after years of exposure to fluorescent light. The result: another example of a magnificent building that uses PLEXIGLAS to obtain lighting of the highest quality.

We will be pleased to send you literature on PLEXIGLAS as a lighting material, and the names of manufacturers whose equipment includes PLEXIGLAS lenses and diffusers . . . for lighting that stands out and stands up.

ROHM & HAAS

PHILADELPHIA 5, PA.

In Canada: *Rohm & Haas Co. of Canada, Ltd., West Hill, Ontario*



Revere hinged poles deliver better lighting through safer and easier maintenance

Revere hinged lighting poles serve every application because there's a size and type for every need. They help assure better lighting through more economical and efficient maintenance — floodlights are quickly, easily and safely lowered to ground level by one man for cleaning and relamping. No elevating equipment is needed, and hazardous ladder-servicing is eliminated.

If your job calls for general-purpose or heavy-duty hinged poles, Revere offers Series 199 square poles in heights up to 24 feet for both base-and-bolt mounting and concrete mounting. These poles accommodate one or two general-purpose floodlights.

If your job calls for heavy-duty hinged poles for one, two, or three floodlights where greater strength is required, Revere offers Series 199E square tapered poles in 20 and 24-foot mounting heights and Series 199D square tapered 30-foot pole.

For mounting as many as five floodlights or a heavy integral luminaire such as the Revere Ultra-Lite, Revere offers Series 199DB square tapered super-heavy-duty hinged poles fabricated of low alloy, high strength steel, available in heights from 24 to 30 feet.

Like all Revere equipment, Revere hinged poles are *design matched* for best appearance and peak lighting efficiency and *structurally matched* for strength, balance, and trouble-free installation and service that means no call-backs. For complete information, features and specifications, write for Revere's brochure on hinged poles, or call your Revere outdoor lighting distributor.

Lowering chain has exclusive spring-lock feature, clips securely on loop at base of lowering arm.

Pole can be locked in raised position with replaceable securing-bolt and ordinary padlock.

Wiring arrangement through hinge pin eliminates twisting and wear of wiring.

Revere ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (in suburban Niles)
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200 • Telegrams: WUX Niles

RVR-1-204

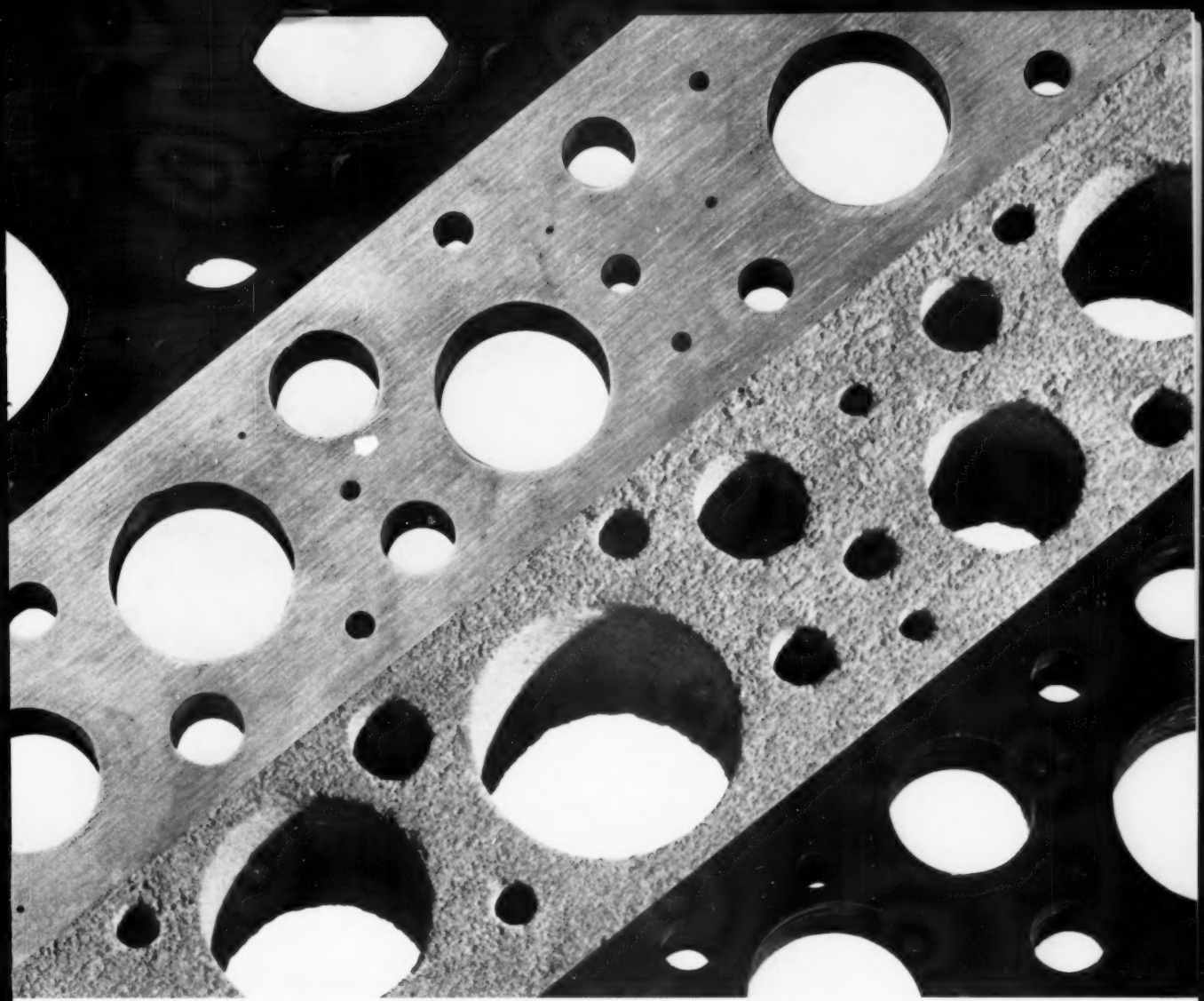
Your lighting projects require the *safest* fluorescent ballasts you can specify . . . General Electric Bonus Line*. These ballasts are designed to protect against leaking, smoking, burning—*all* potential hazards or annoyances at end of life. They feature a unique, non-resetting thermal protection system—better than the best fusing—for unmatched, incident-free operation throughout their full, useful life. Put the fullest measure of lighting protection into your buildings. Write premium-quality General Electric Bonus Line ballasts into your lighting specifications.

*Trade-mark of General Electric Company

For a detailed engineering report on Bonus Line ballasts, contact your G-E Sales Engineer or write Section 403-03, General Electric Company, Danville, Illinois.

Progress Is Our Most Important Product

GENERAL ELECTRIC



There's a Black & Decker Drill for every hole on this page

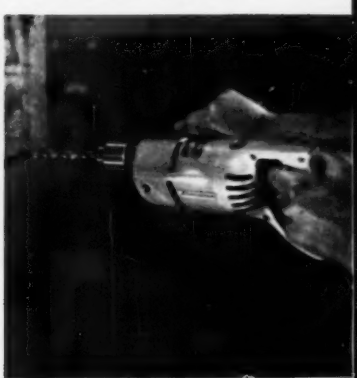
And now for every Black & Decker Drill (all 58 of them), there's 20-25% longer life, extra drill power, handier handling. These built-in bonuses attest best to the tool engineering and design that never follows, always leads. ⇨ ⇨ ⇨

New Motor Varnish—insulates motor wire for running-temperatures up to 38% higher, increases overload capacity as much, and adds to motor life.

Advanced Commutator Lead Fusing gives better bonding at higher temperatures. New carbon brushes get 50% longer life, cut commutator wear.

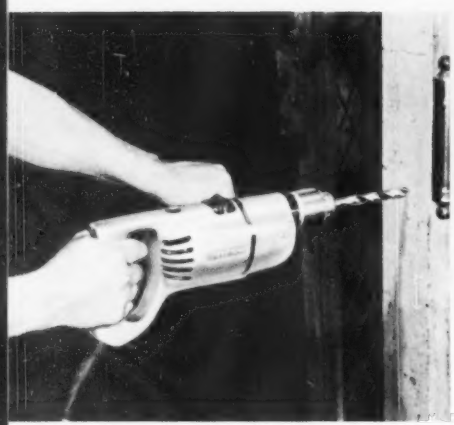
Improved Cooling System uses new-design fans, larger ventilating holes to make every Black & Decker Drill the coolest handling tool for the job.

More Power Per Pound in every B&D Drill helps you get through your work quicker and cleaner. Contour handles afford the easiest grip, too.

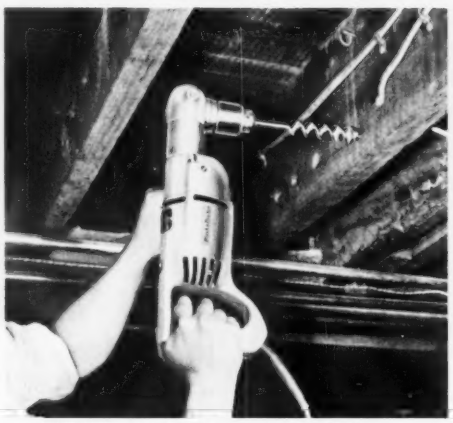


BLACK & DECKER'S LONGER LIFE LINE

58 B&D Drills get through the work faster, easier . . . have more drill power to last longer

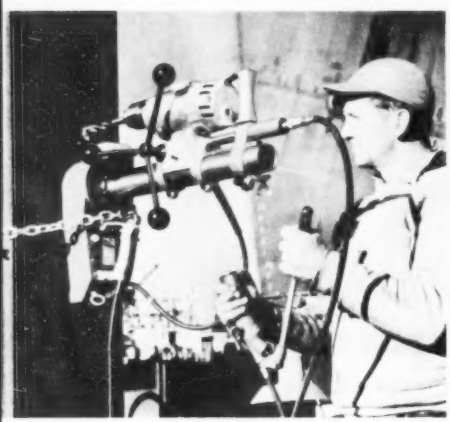


NEW! ½" End Handle Drill is ideal for tough construction jobs. So powerful it has 48 ft./lbs. lock torque, the highest of any comparable tools.

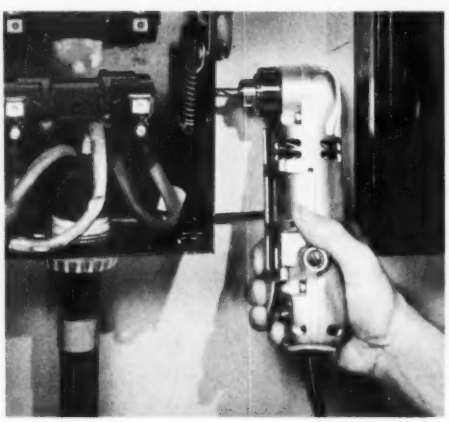


NEW! ½" Right Angle Drill has a head for getting around corners, between joints and pipes. Reverse end attachment to speed up or slow down.

REDESIGNED! ¼" End Handle Drill has a slimmer, more compact profile, ball-bearing construction. Features long-life, cooler-running motor.



Magnetic Drill Press in ¾" and ¼" sizes, sticks to the job in any position. 2-speed 1¼" also available. All models reverse. Manual or remote control.



¼" Shorty Drill is a compact little helper that works in and out of the tightest quarters with special ease. Twin fans make this a cool tool, too.

⅜" Reversible Scru-Drill® is a drill and screwdriver in one. Drives or removes screws, nuts and bolts; drills ⅜" capacity in steel, ¾" capacity in wood.

THE BLACK & DECKER MFG. CO., Dept. DC-36
Towson 4, Md. (In Canada: Brockville, Ont.)

☐ Please arrange for a demonstration of.....

☐ Please send me more information on.....

Name.....Title.....

Company.....

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☐ Vacuum Cleaners

☐ Screwdrivers

☐ Hammers

☐ Portable Grinders

Black & Decker®

CUTS MAN-HOURS TO MINUTES

Every bit counts . . . when you go through construction jobs with any one of Black & Decker's 58 drills. Power? B&D's newly beefed-up motors won't back down in the toughest going. Handling? When you grip a B&D Drill naturally, it's never off-balance, always easy to handle. Durability? Black & Decker Drills lead a rugged life — and love it! Sold at leading distributors everywhere. *For sales or service, look in the Yellow Pages of your telephone book under* TOOLS ELECTRIC

This man won't be back...

The specifications read: PERMANENT GROUNDING. They used CADWELD Electrical Connections knowing that they are permanent, cannot loosen or corrode and have a greater current carrying capacity than the cable itself.

No maintenance is ever required on a CADWELD Electrical Connection.

CADWELD offers: 1. Engineering Service, 2. Field Service.

CADWELD®

Erico Products, Inc.

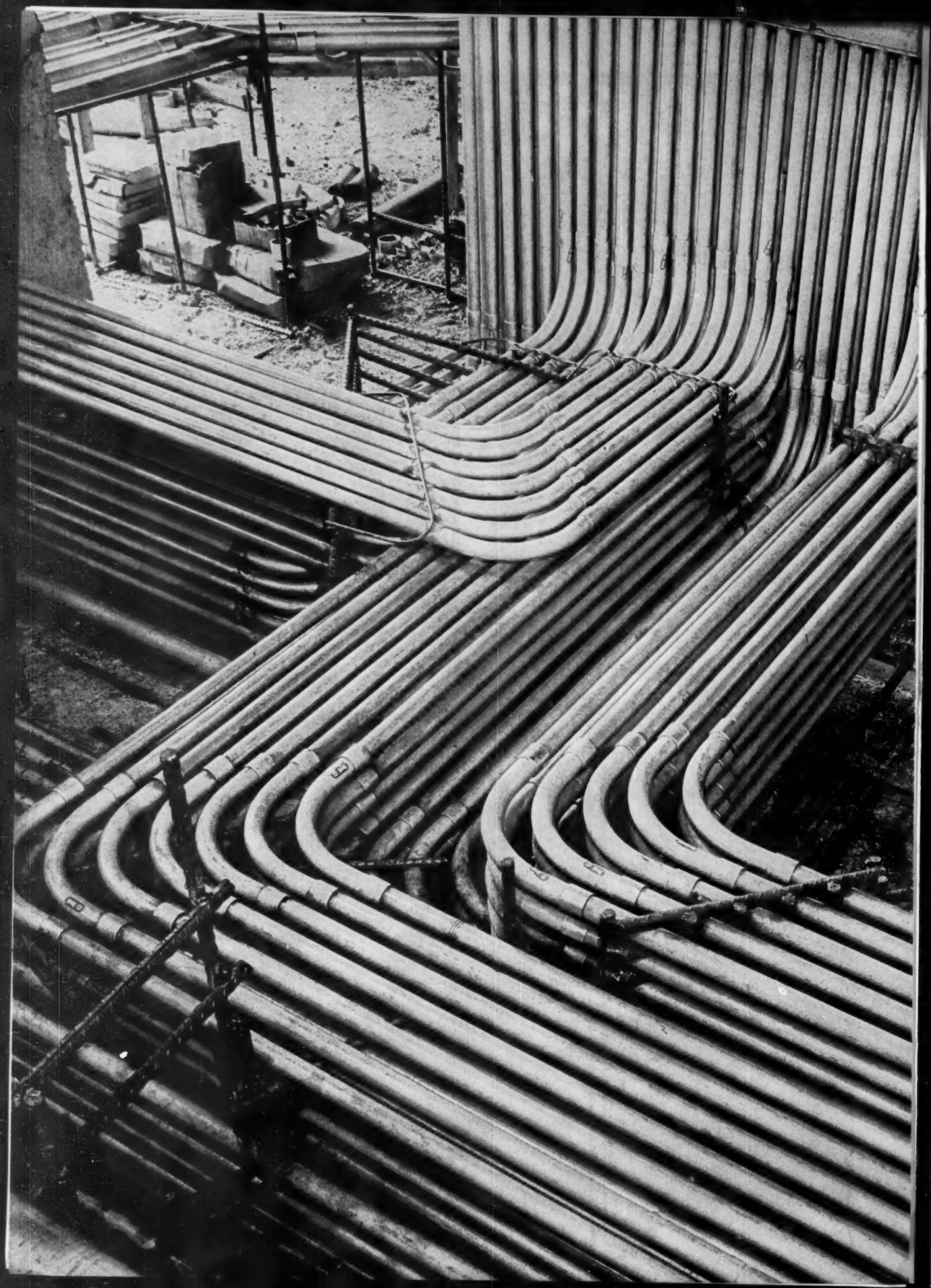
2070 E. 61st Place • Cleveland 3, Ohio

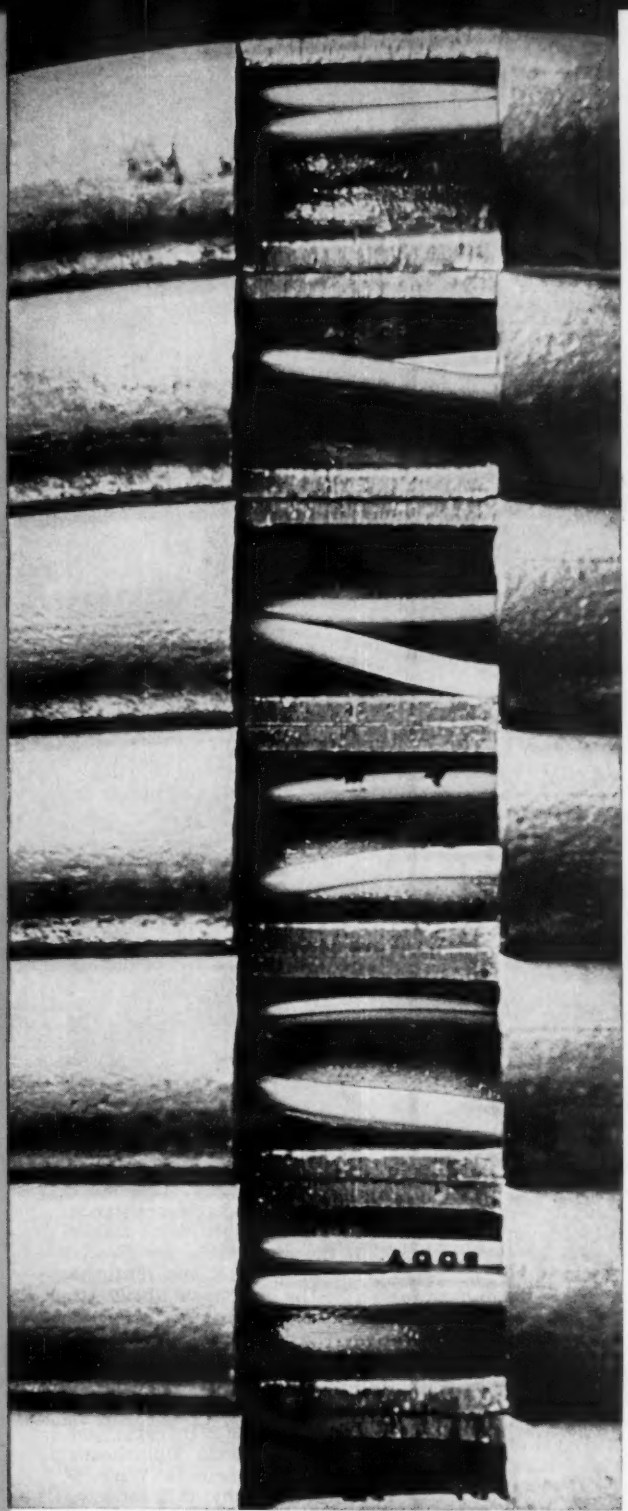
IN CANADA: ERICO INCORPORATED, 7 Superior Ave., Toronto 14, Ontario, Canada

In every profession, one instrument gets to the heart of the problem quickest, easiest, and most accurately. Amprobe is the stethoscope of the electrical industry

The Amprobe RS-3* enables you to take voltage, current and resistance readings to help diagnose electrical "ills." It saves you time and effort; it adds to your reputation for ability and service. Here are a few typical applications. Ask your distributor or write today for more details: ■ determine current loads of power equipment ■ make commercial and industrial load surveys ■ identify unmarked motor terminals ■ test for low-voltage conditions ■ check resistance in solenoid coils. *Only $52.50 (slightly higher outside U.S.).

AMPROBE INSTRUMENT CORPORATION
630 MERRICK ROAD, LYNBROOK, NEW YORK
CANADA: ATLAS RADIO CORP., 50 WINGOLD AVE., TORONTO





BENDS

Youngstown steel conduit offers greater bendability for modern electrical raceway construction

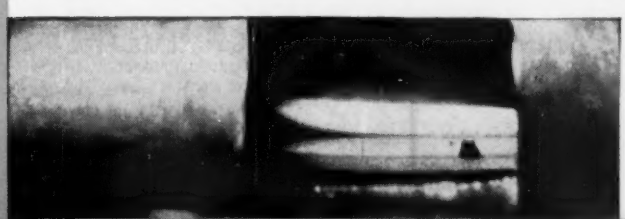
You can turn the hard corners. Twist. Bend again. Meet impossible raceway demands with Buckeye and Yoloy rigid steel conduit by Youngstown. It is easier to work with. It is easier to bend where you want it . . . without flattening, without creasing, without cracking its tough elastic finish. With Youngstown conduit you get the smoothest raceway possible for easy wire pulling.

Sizes: ½" to 4" available in Youngstown continuous weld pipe, 5" to 6" sizes in Youngstown standard weight seamless pipe. All are products of modern, integrated facilities where Youngstown carefully controls quality from ore to mill to final automatic bundling.

Get Buckeye from your Youngstown Distributor if your job is typical. Ask for Yoloy if specs call for greater corrosion resistance.

Get conduit from the world's largest producer of rigid steel conduit: Youngstown.

Youngstown – growing force in steel

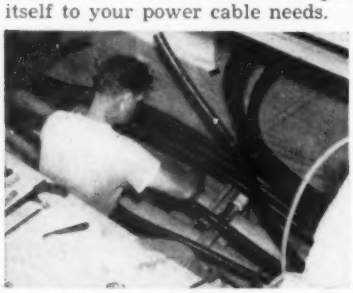


For full details on Buckeye and Yoloy Conduit write to: Dept. 26-D
The Youngstown Sheet and Tube Company, Youngstown, Ohio

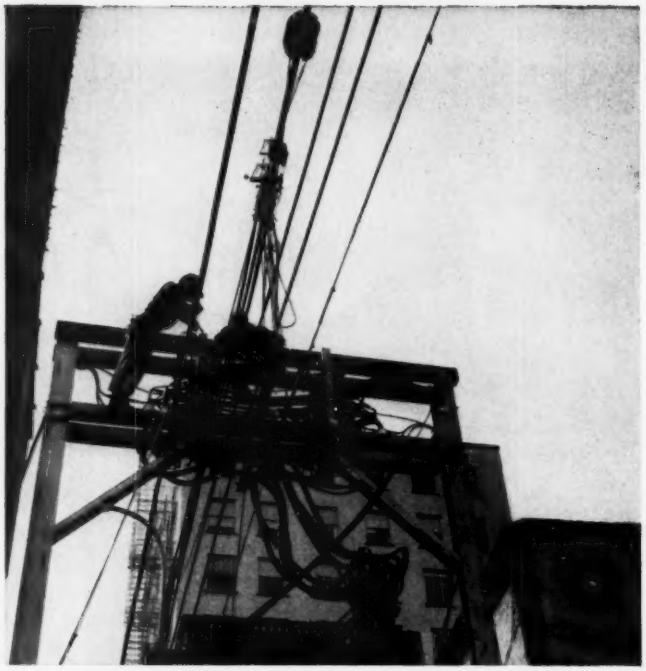
NAME YOUR CABLE PROBLEM— THERE'S A GOOD CHANCE DURASHEATH CAN SOLVE IT.

Durasheath is versatile, easy to install—indoors, outdoors, above ground or below. Here are 5 examples.

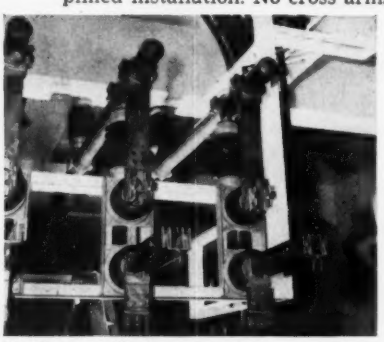
Riser Cable. In this installation, Durasheath not only serves as an aerial cable, but also as a riser cable running down the side of the building. Without additional terminations, it then drops down-inside to the plants' power-control center. It's another example of the way versatile Anaconda Durasheath adapts itself to your power cable needs.



Installed in ducts. Durasheath's flexibility meant quick and easy installation here. And once installed, its tough neoprene jacket assures long, trouble-free life. Because Durasheath adapts itself to so many uses, your inventory problems are lessened—fewer cables need be carried in stock.



Field or factory-assembled aerial cable. Durasheath may be factory pre-assembled with standard or reverse lay. Or it can be quickly field assembled with the simple spinning operation shown here. Either way, easy splicing, tapping, and terminating result in simplified installation. No cross arms or insulators are needed.



Inside installation. Here's an application where Durasheath was quickly installed and easily terminated. Durasheath's Neoprene jacket resists abrasion, heat and fumes. *Assures dependable performance and long-range economy.*

Direct-burial cable. The moisture-, oil-, and acid-resistance of Durasheath's jacket makes it the ideal cable for direct-in-the-ground applications like the one shown above. Its flexibility cuts installation time and cost because Durasheath is easy to handle. Its durability cuts maintenance costs.

ANACONDA DURASHEATH ALL-PURPOSE POWER CABLE is available in all sizes, single and multiple conductor, copper or aluminum, 600 to 35,000 volts. *Insulations:* Type RHW, Anaconda ANW, AHW, or AB butyl rubber compounds; each designed for specific purposes. *Jacket:* specially compounded neoprene with high resistance to flame, oil, acids, alkalies, sunlight, and ozone. Has high tensile strength and is flexible over a wide range of temperatures.

For complete information about Anaconda Durasheath contact Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York, Department EFL-1-EC & M.

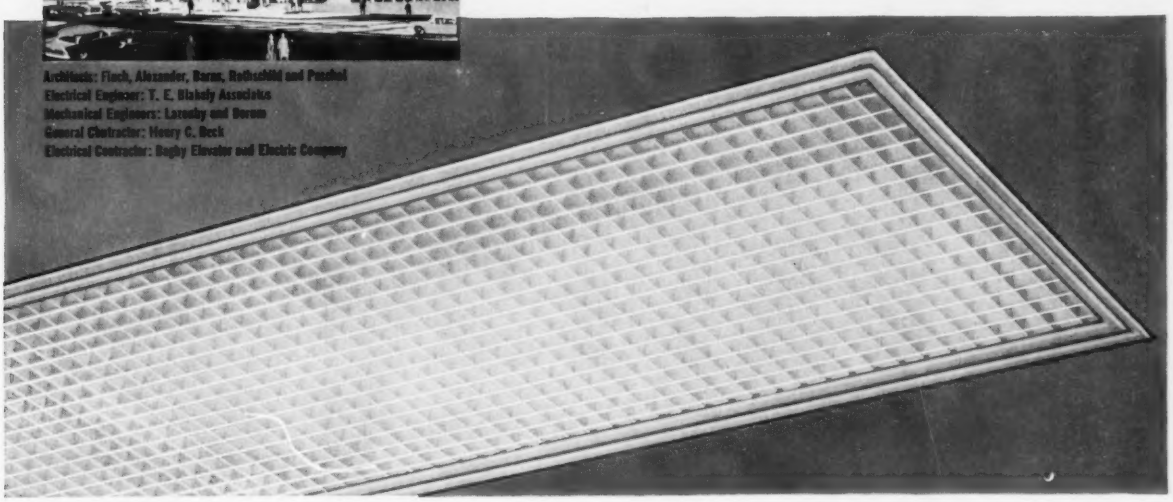
61266-C

ASK THE MAN FROM
ANACONDA
FOR DURASHEATH ALL-PURPOSE POWER CABLE

Architects: Finch, Alexander, Barnes, Rothschild and Paschal
Electrical Engineer: T. E. Blakely Associates
Mechanical Engineers: Lazenby and Doreen
General Contractor: Henry C. Beck
Electrical Contractor: Bagby Elevator and Electric Company

Where there's light... there's heat.

And that, in a capsule, is one of the "hottest" subjects in the lighting industry. As the demand for higher lighting levels has continued to grow, the problems of utilizing (or disposing of) the additional heat generated has become a matter of vital concern to designers. The architects and engineers for the Georgia Power Company's new building designed a climate control system to utilize lighting heat in winter, thus achieving the economy of a smaller heating plant.



Up to 200 footcandles with direct glare fully controlled. That's what the Georgia Power Company, heeding the Blackwell study, wanted for its new building—and that's what Wakefield delivered.

Starting with a standard Wakefield 2′ x 4′ four lamp hinged and framed troffer, Wakefield engineers developed a special anodized aluminum louver that handles such high illumination levels and exactly meets the direct glare requirements of the IES curve.

The units have no end caps and join together to create unbroken rows of light. Their shallowness (4⅞″) fits the access plenum area which is 5⅛″ deep. Some units were modified to a 4″ depth to fit a 4⅜″ plenum in certain areas, eliminating the need to lower the ceiling at those points.

Here is an excellent example of how a standard Wakefield troffer can be modified to meet a customer's particular needs. We can do as much for you.

Hinged framed louver disconnects for on-the-floor cleaning. Body is 20 gauge steel. Reflecting surfaces are infra-red white baked enamel. All electrical components carry UL labels.

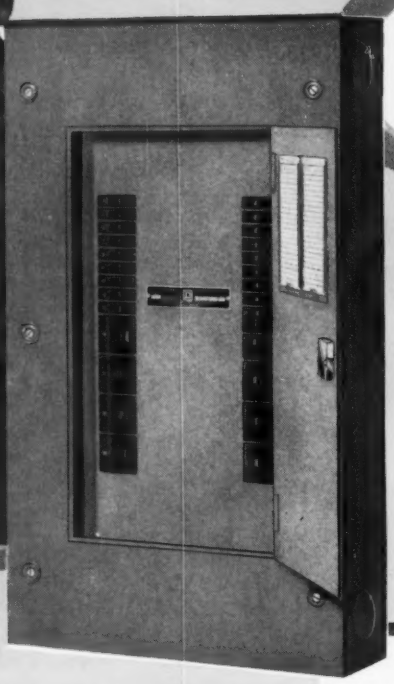
WAKEFIELD CORPORATION

ELECTRICAL PRODUCTS GROUP
Wakefield Lighting Division — Vermilion, Ohio
Wakefield Lighting Limited — London, Ontario

Art Metal Lighting Division — Cleveland 3, Ohio
1814 East 40th St.
Sta-Warm Electric Company — Ravenna, Ohio

SAVE- space time money

Same PANELBOARD LIGHTING AND

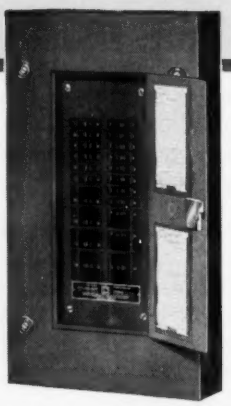


Heavy Duty Construction!

NQO Panelboard

400 or 600 amp Mains

• Why waste time, space and money by installing separate lighting and power panelboards? Square D now makes it easy to combine 120 and 240 volt lighting and power loads up to 100 amperes, into one panel. Equally important, thanks to plug-in design and a complete range of circuit breakers (*see opposite page*), you can get a real heavy duty industrial type panelboard with exactly the circuits you need—right out of your Square D distributor's stock.*



100 or 225 amp Mains

*NQO (plug-in) and NQOB (bolted connection) panelboards are also available factory-assembled for shipment direct to the job

SQUARE D COMPANY

COMBINES *Both* POWER LOADS!

FINEST BREAKER EVER BUILT!

THE QO FAMILY

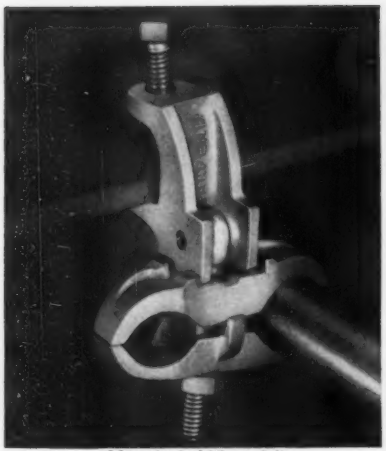
QO 1-POLE 15-50 Amp	QO 2-POLE 15-70 Amp	QO 3-POLE 15-60 Amp	Q1 2-POLE 70-100 Amp	Q1 3-POLE 70-100 Amp

D ...*design leadership* FEATURES

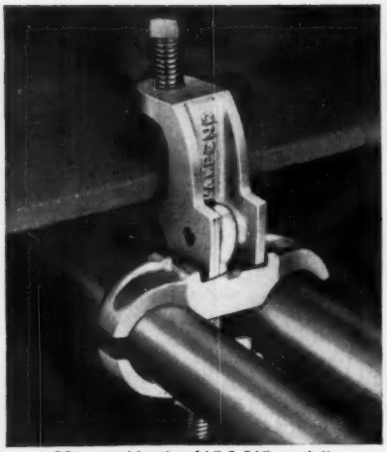
- Complete flexibility. Plug-in circuit breakers available up to 100 ampere three-pole in any arrangement.
- Distributed phase bussing—reads like a wiring diagram. Two and three-pole breakers may be mounted anywhere in the panelboard.
- Plenty of wiring room. 5" end gutters with 100 and 225 ampere mains; 8" end gutters with 400 and 600 ampere mains.
- Main lugs approved for aluminum or copper wire—both main breaker and main lugs.
- Heavy duty enclosure. Galvanized steel boxes, full finished trim with a solid door.
- *Qwik-Open* feature of lighting breaker prevents damage due to high resistance or "arcing" faults.
- Ambient temperature compensation prevents nuisance tripping in high temperatures.
- Trip indication tells instantly whether circuit has been turned off intentionally or has "tripped."
- Temperature-compensated—prevents nuisance tripping.
- Common trip prevents single phasing or personal injury.
- Single handles on two and three-pole breakers for modern, streamlined appearance.
- Plated jaws and connectors assure positive connections.
- Heavy duty industrial quality for long life and trouble-free operation.

***Write** for the complete story*
Address Square D Company, 1601 Mercer Road, Lexington, Kentucky

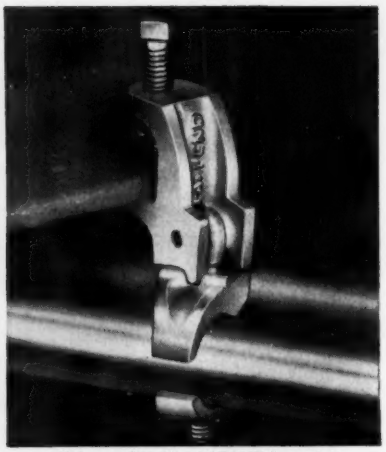
wherever electricity is distributed and controlled



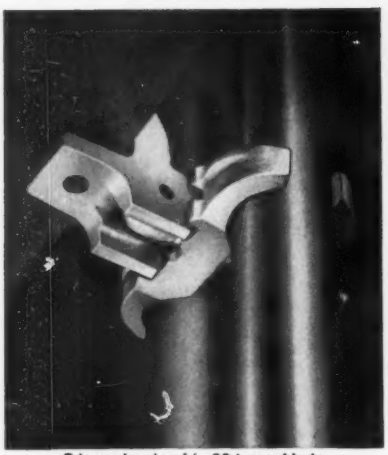
90°—single ½" conduit



90°—combination ½" & ¾" conduit

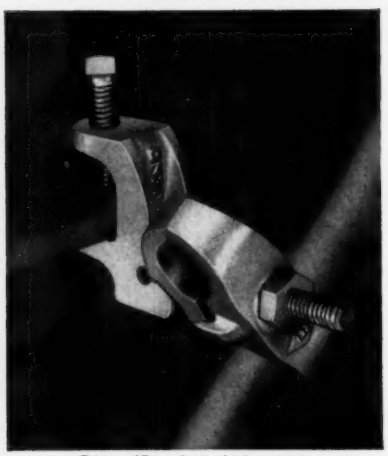


45°—combination ¾" EMT & conduit

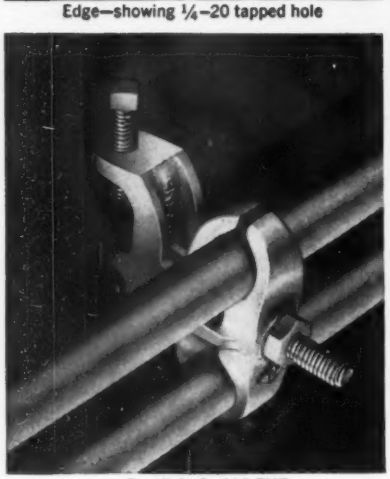


Edge—showing ¼–20 tapped hole

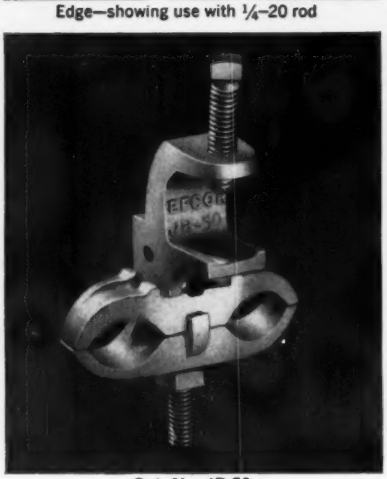
Edge—showing use with ¼–20 rod



Edge—45°—single ½" conduit



Parallel—2—½" EMT



Cat. No. JB-50

Make all these installations with just a single new EFCOR ALLWAY* Beam Clamp

Soon available for 1" & 1¼", 1½" & 2"

Most versatile beam clamp ever designed! Each clamp holds either one or two conduits—each conduit grip takes two sizes! Clamping section can be swiveled to any plane, all angles—becomes a 90°, edge or parallel clamp... whatever the installation calls for. No need to stock a variety of types . . . you never run short of the clamp you need. One EFCOR ALLWAY Beam Clamp does it all. And gives you the greatest combination of economy and on-the-job convenience! Write for literature:

Efcor

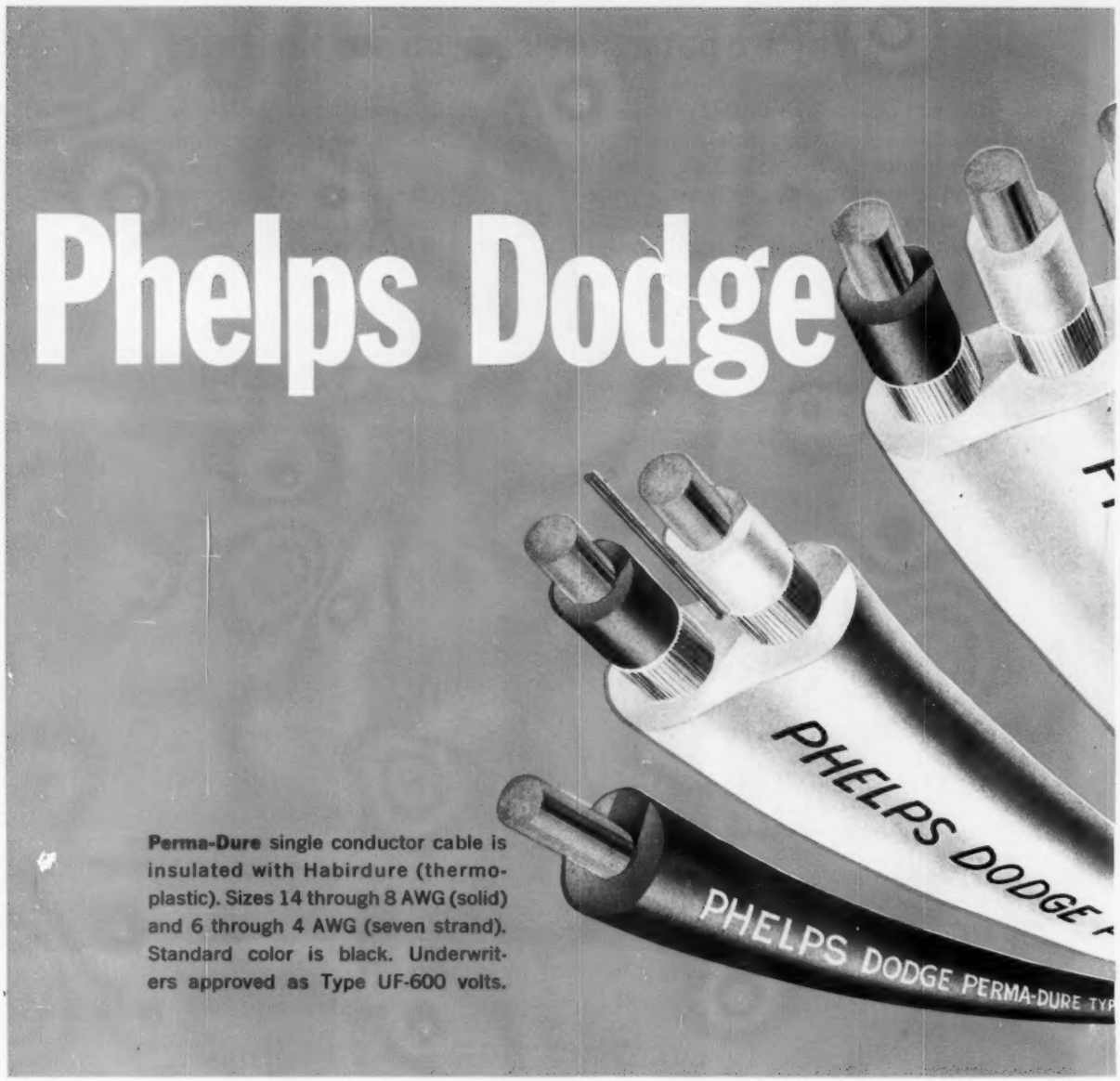
*pat. pend.

ELECTRICAL FITTINGS CORPORATION, EAST FARMINGDALE, NEW YORK

Why we put a nose cone on our fasteners

Four important reasons. 1) To hold the fastener in the barrel. 2) To guide the fastener and assure straight penetration. 3) To automatically clean the tool's barrel between fastenings. 4) To show visual proof of proper penetration. Without that patented "nose cone" and without our austempering process, we could never guarantee 100-for-100 fasteners and sleep nights. This way, you get the guarantee, and we get some rest. More powder actuated fastenings are made with Ramset red-tipped fasteners than all others combined. For immediate delivery call your local Ramset dealer. He's listed in the Yellow Pages under "Tools." You can count on him for on-the-site deliveries.

Ramset WINCHESTER-WESTERN DIVISION **Olin**
285-J Winchester Ave., New Haven 4, Conn.



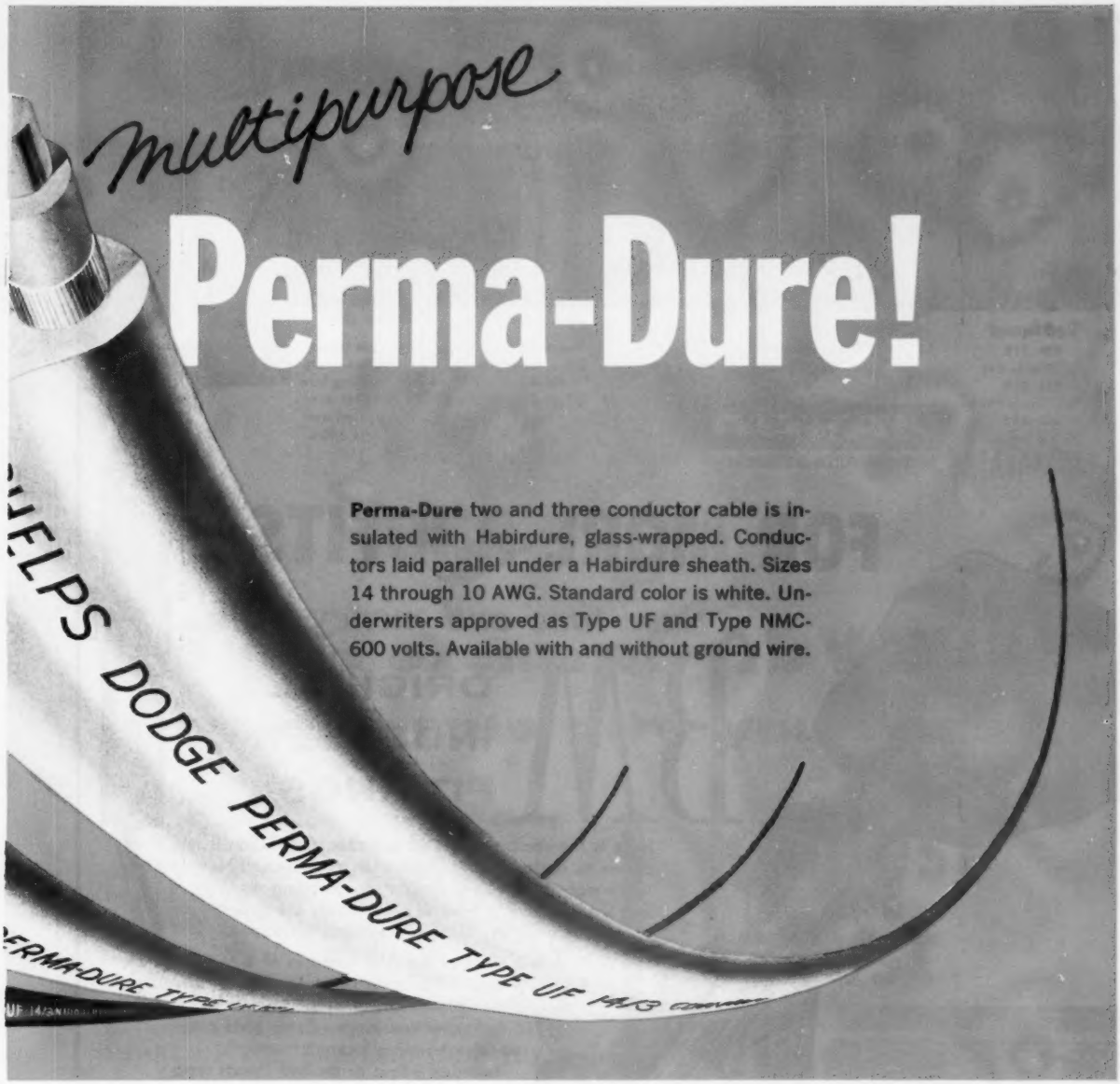
Perma-Dure single conductor cable is insulated with Habirdure (thermoplastic). Sizes 14 through 8 AWG (solid) and 6 through 4 AWG (seven strand). Standard color is black. Underwriters approved as Type UF-600 volts.

An Economical, Dependable Cable for • Underground

Perma-Dure, a Phelps Dodge product, provides electrical contractors with a durable, versatile type of flame-resistant cable for industrial and commercial use.

Perma-Dure handles easily, strips readily and helps cut installation time and costs. It is supplied in single, two and three conductors for feeder or branch circuits. Under the 1959 National Electrical Code, *Perma-Dure* is recognized as suitable for:

Type UF, single and multiple conductor, as feeder or branch circuit cable, for direct burial in the earth when provided with over-current protection.



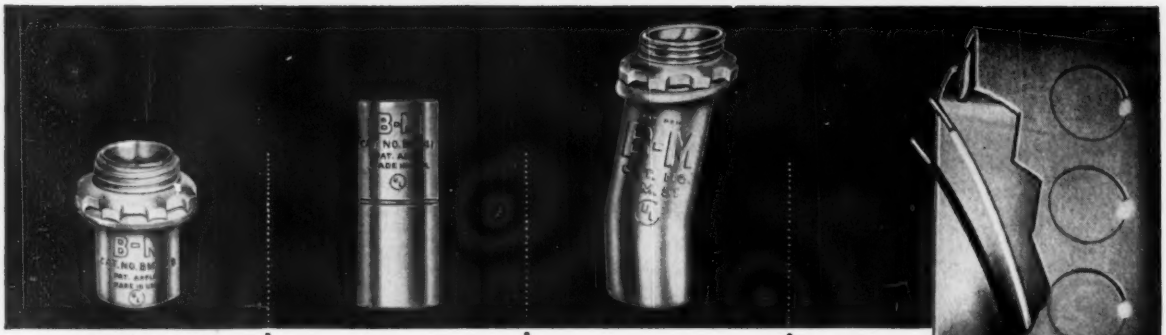
Wiring Including Direct Burial • Interior Wiring

Type NMC, multiple conductor (moisture and corrosion resistant non-metallic sheathed cable) for installation in exposed or concealed locations, in dry, damp or corrosive conditions; inside masonry or tile walls; or embedded, when suitably protected, in plaster or shallow chase in masonry.

See Your Phelps Dodge Distributor!

PHELPS DODGE COPPER PRODUCTS
CORPORATION
300 Park Avenue, New York 22, N. Y.

P MINE TO MARKET D



Red Throat
BM-21B
½" Connector
BM-22B
¾" Connector
BM-23B
1" Connector

BM-41
½" Coupling
BM-42
¾" Coupling
BM-43
1" Coupling

BM-51
½" Offset Connector
BM-52
¾" Offset Connector

BM Offset Connectors showing how wires are guided over box edge.

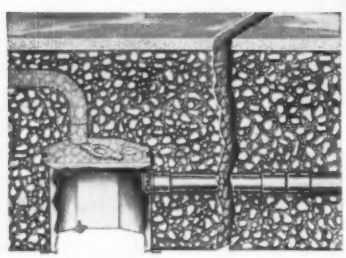
FOR MORE PROFITS

Save time and money with

B-M ORIGINAL INDENTER FITTINGS

Here is the combination that is unbeatable when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws.

A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.



ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

When setting E.M.T. in concrete you can make each job easier and more profitable by using Briegel All Steel Indenter Fittings that have UL approval as Concrete-Tight. Contractors everywhere recognize their cost cutting qualities and the fact that they make each wiring job a better job. It is only natural that Briegel Fittings are the most widely used E.M.T. connectors and couplings.

BM PLIER SIZE INDENTERS
BM—No. 607 ½"
BM—No. 608 ¾"

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

USED THE MOST FROM COAST TO COAST

ADVANCE®

KOOL KOIL

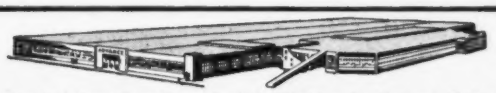
These exclusive ADVANCE developments give you the . . .

Through outstanding engineering developments and modern manufacturing facilities, ADVANCE TRANSFORMER COMPANY has become the world's largest manufacturer devoted exclusively to the production of quality fluorescent lamp ballasts. These precision built, power regulating instruments supply exacting amounts of electrical energy for the efficient operation of all fluorescent lamps and are aptly called "THE HEART OF THE LIGHTING INDUSTRY."®

Continuing research and constant new developments in both engineering and manufacturing divisions have made possible the introduction of many new ballasts with exclusive patented features. Thus, ADVANCE provides lighting equipment manufacturers, designers, architects, engineers, contractors and other fluorescent lamp ballast users the world's most extensive line of fluorescent lamp ballasts. When you use ADVANCE, there is a ballast for every specific purpose, never a need to compromise.

koolest
safest
quietest
FLUORESCENT LAMP
ballasts
IN THE WORLD

"The Heart of the Lighting Industry."®

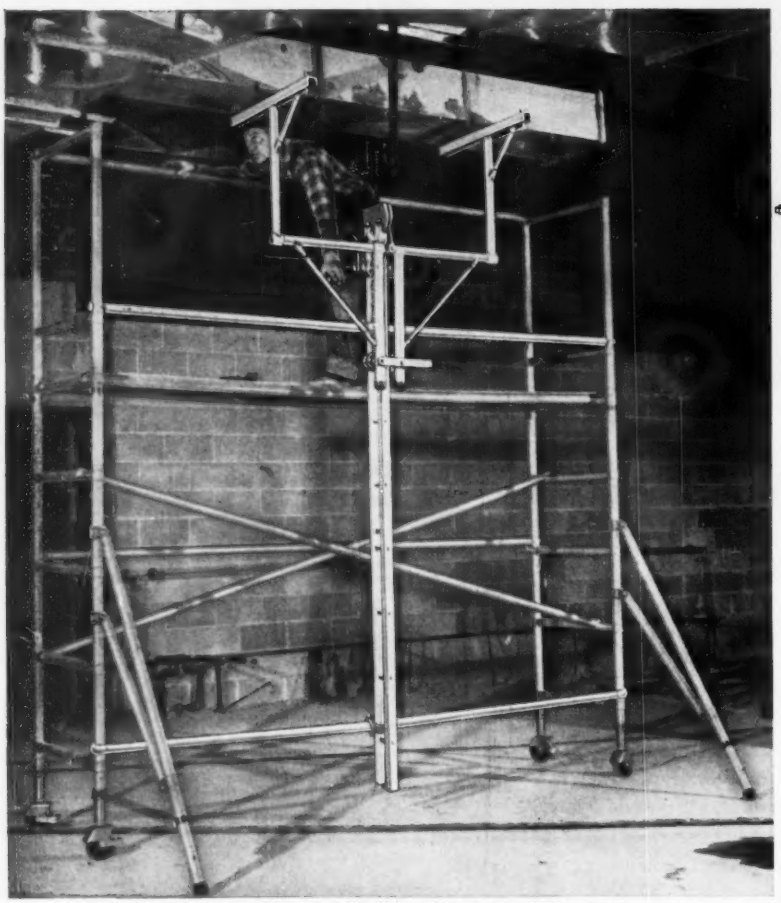


In Canada: Advance Transformer Co. Ltd., 5780 Pare St., Montreal, Quebec.

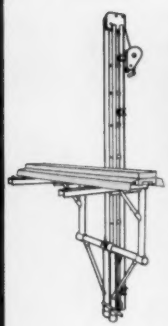
ADVANCE TRANSFORMER CO.
WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF FLUORESCENT LAMP BALLASTS
CBM CERTIFIED
2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

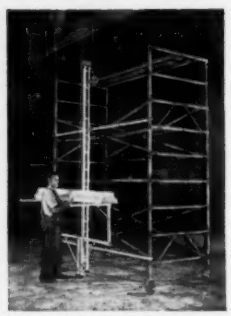
Double your workman's production...

UP-RIGHT mechanical man lifts & positions material for fast, one-man installation

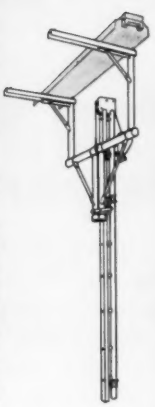


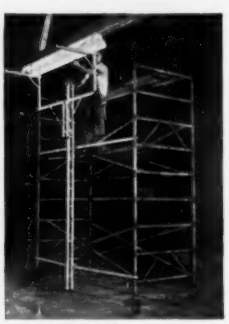
Workman and mechanical man accurately position 9 ft. long air duct for easy, rapid installation.



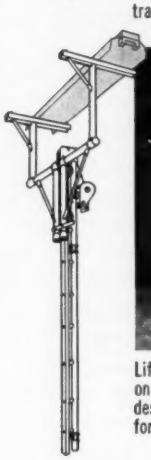


Fixture is placed on lifting arms at convenient chest height.





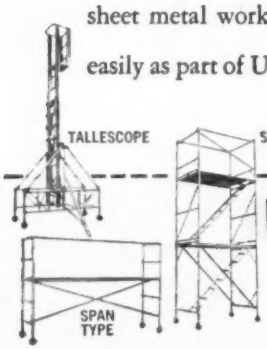
Fixture is elevated along vertical track by winch.



Lifting arms move horizontally on rollers and elevate fixture to desired position above workman for fast, convenient installation.

Mechanical man is an aluminum hoist assembly instantly attachable to any Up-Right or other scaffold. It saves fatigue and manhours in positioning fluorescent fixtures, bus-ducts, conduit, pipe and sheet metal work for overhead installation at any height. Rolled easily as part of Up-Right aluminum scaffold.

Write for descriptive circular



UP-RIGHT SCAFFOLDS

DEPT. 177 1013 PARDEE, BERKELEY, CALIFORNIA

In Canada: Up-Right Scaffolds Ltd., 120 Russet Ave., Oshawa, Ontario

COLD WEATHER ?

FREE SAMPLE ! SCOTCH® BRAND ELECTRICAL TAPE No. 88

FIRST ALL-WEATHER ELECTRICAL TAPE

Now at last a "super" tape to handle the toughest cold weather splicing jobs. New "SCOTCH" BRAND Electrical Tape No. 88 is 20% thicker than ordinary plastic tapes. Retains its easy handling properties and "feel" under all temperature conditions. UL approved. Resists acids, abrasion, alkalies, oils and weathering. Send in the coupon for free 9 ft. sample roll.

Made by the makers of "SCOTCH" BRAND No. 33 Electrical Tape.

SEND IN TODAY

3M Co., 900 Bush Ave., St. Paul 6, Minn., Dept. EAA-101

Send me a free sample roll of "SCOTCH" BRAND Electrical Tape No. 88

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

3M MINNESOTA MINING & MANUFACTURING CO. **Electrical Products Division**

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN.

"Notes from underground"

A short play on words and conduit

White hat: Boy! This tunnel is sort of airless and closed-in, isn't it? Almost like a . . . well a . . . never mind. Show me those steel raceways.

Dark hat: Right here. Been buried down here for years, but they look good as new. How do you think you'd look after being buried down here all those years?

White hat: Miserable, miserable.

Dark hat: You don't have to cover these steel raceways with any organic material when you run them through concrete, or along it.

White hat: Great! Just the kind of good, solid facts I need. Now let's get back topside, shall we?

Dark hat: You don't have to baby steel conduit, either. It takes plenty of rough handling and you can bend it without worrying about flattening or wrinkling.

White hat: About wraps it up, doesn't it? Let's go up and get some of that fresh air.

Dark hat: And steel conduit's a snap to install. You can thread it with regular dies and you don't need special lubricants.

White hat: I see.

Dark hat: Steel conduit gives you a grounded metallic system; induced currents are drained off without danger.

White hat: Let's ah . . . let's go up, huh?

Dark hat: Steel conduit's got a smooth interior, too; makes it easy to pull wires and cables, and saves a lot of time and money if you ever have to rewire. What's the matter, mister? You look all white. Maybe you ought to loosen your tie. Mister? Hey, mister?

USS TRADEMARK

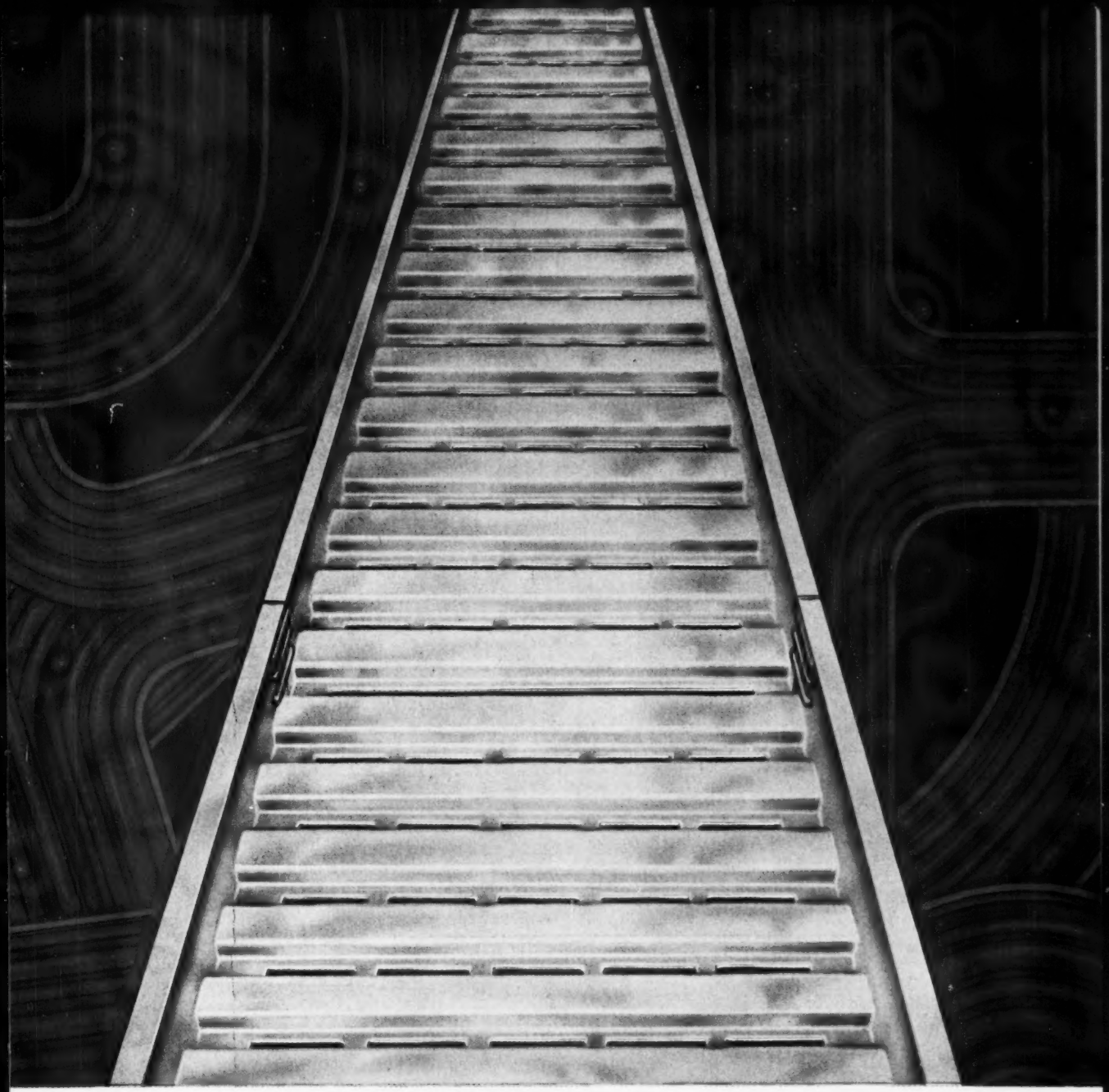
National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors

United States Steel Export Company, New York

America's leading steel pipe manufacturer supplying America's foremost conduit manufacturers.

This mark tells you a product is made of modern, dependable Steel.



New *HUSKY* Ventrib*!

The low cost cable-carrier, quality engineered with Husky experience

The VENTRIB basket carrier is Husky's new, low cost addition to its growing line of cable support systems. Primarily designed to handle control cable, it is carefully pre-engineered for simple installation. Unusual slotted design provides maximum ventilation while permitting easy banding and/or clamping of cable. The overall corrugated VENTRIB design achieves optimum strength with a minimum of weight. Adhering to the highest standards of Husky workmanship and design, the VENTRIB basket carrier is supplemented by a full line of fittings and support materials.

Available in most popular industry sizes, VENTRIB is stocked for 24 hour shipment. For the latest word on this new Husky system, write for the VENTRIB catalog.

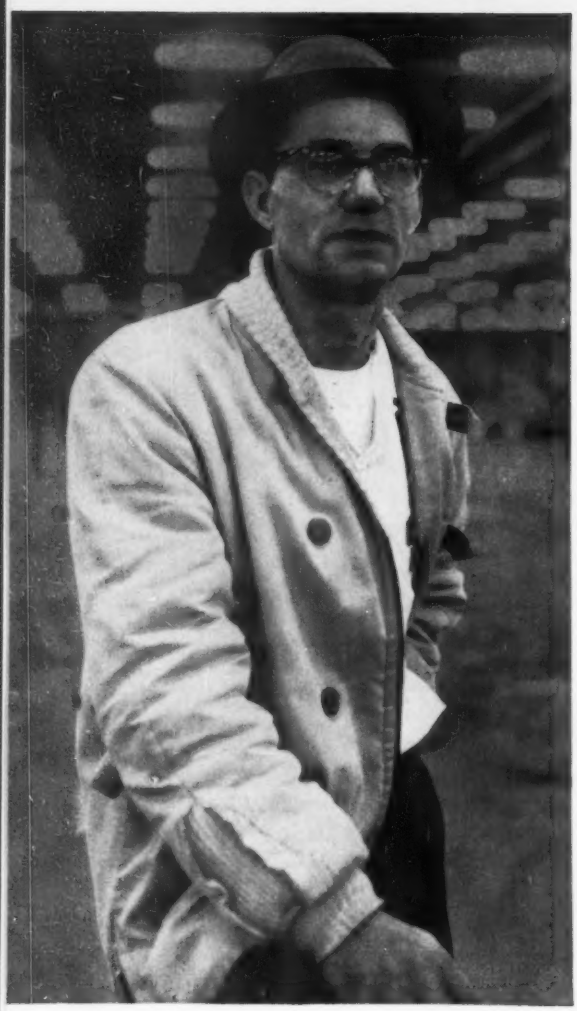
HUSKY – DIV. OF **BURNDY** CORP., 5300 VINE ST., CINN. 17, OHIO

QIKLOK* Coupling Secures Sections Sound mechanical joint with 3 prong coupling. Ease of installation saves time and money.

*TM
01-59

JOB-PROFIT TOOLING IDEAS

FROM GREENLEE



"On this warehouse job GREENLEE ONE-SHOT BENDERS cut bending time 80% for 1-1/2 to 3-1/2" diameter aluminum conduit,"

says ELMER BERINGHAUS,
field superintendent,
BECKER ELECTRIC COMPANY,
Cincinnati, Ohio

"Using Greenlee tools on this electrical contract enabled us to make neat, professional conduit installations in less time and with fewer couplings and fittings," reports Elmer Beringhaus, field superintendent for Becker Electric Company of Cincinnati.

"With our new Greenlee one-shot bender, a 90° bend in 3½" aluminum conduit takes about six minutes compared with 30 to 40 minutes using our previous method . . . a timesaving of 80% on every bend."

"We had to make nearly 300 bends in conduit ranging from 1½ to 3½" in diameter on this warehouse and service area job. A large percentage of the conduit was put in before the concrete floor was poured," Beringhaus stated. "Heavy, hard-to-move benders were out of the question in the kind of mud we had here. We selected a Greenlee bender because it's rugged, lightweight, and fast . . . and one man can move it and set it up. It has proved ideal for the type of on-the-site work we had on this contract."

See the facing page for pictures and stories of how Greenlee Job-Profit Tooling saved time and money on this $150,000 electrical contract.

"One man now does the work of two using the Greenlee No. 884 lightweight hydraulic one-shot bender for pipe and conduit. Our old benders required as many as 20 or 21 shots to make a 90° bend in 4" stock," Superintendent Beringhaus reports. "And two men were needed to align and level the conduit after each shot. Sometimes a complete bend had to be rejected because it wasn't smooth or level. This cost us time and money.

"With our new Greenlee one-shot, one man can make the setup and complete a 90° bend in aluminum pipe in about 1/5 the time formerly required — a substantial saving over our previous method." As the picture above shows, Becker powers its benders with a Greenlee No. 798 AC-SA hydraulic power pump. This pump is known throughout the industry for dependable, maintenance-free performance.

"The fast accurate way to make openings in junction boxes," states Beringhaus, "is with Greenlee knockout tools. We used a Greenlee No. 7310 hydraulic knockout punch driver and the punch sets shown here to make more than 200 conduit openings ranging from 1¼ to 4" in diameter. The fast cutting action of these units makes punching clean, uniform openings a snap."

The tools Becker Electric Company uses must be light, mobile, and fast-acting. They also must be able to take a real beating, as this job proved. Albert Osborn, Becker purchasing agent, reports that "there have been no repairs or maintenance on any Greenlee equipment used on this job."

Two new additions to the Greenlee line of Job-Profit Tooling

NEW lightweight (14 lb) hydraulic power pump

The Greenlee No. 1729 pump is a handy power source for hydraulic knockout punch drivers, rams, jacks, pullers, and similar tools with high-pressure, low-volume requirements. Two speeds . . . fast approach. High pressure to 10,000 psi.

NEW pipe holders for Greenlee benders

Greenlee No. 1803 pipe holders, designed for use with Greenlee benders, prevent "wows" and "dog legs" during segment and offset bending operations.

Pipe holders clamp quickly to each end of the pipe to keep it level and parallel with bender shoes and pipe supports. One size fits pipe from 1¼ to 4" in diameter.

GREENLEE JOB-PROFIT TOOLING includes over 100 different types and sizes of timesaving equipment designed to help electrical contractors streamline operations and control costs.

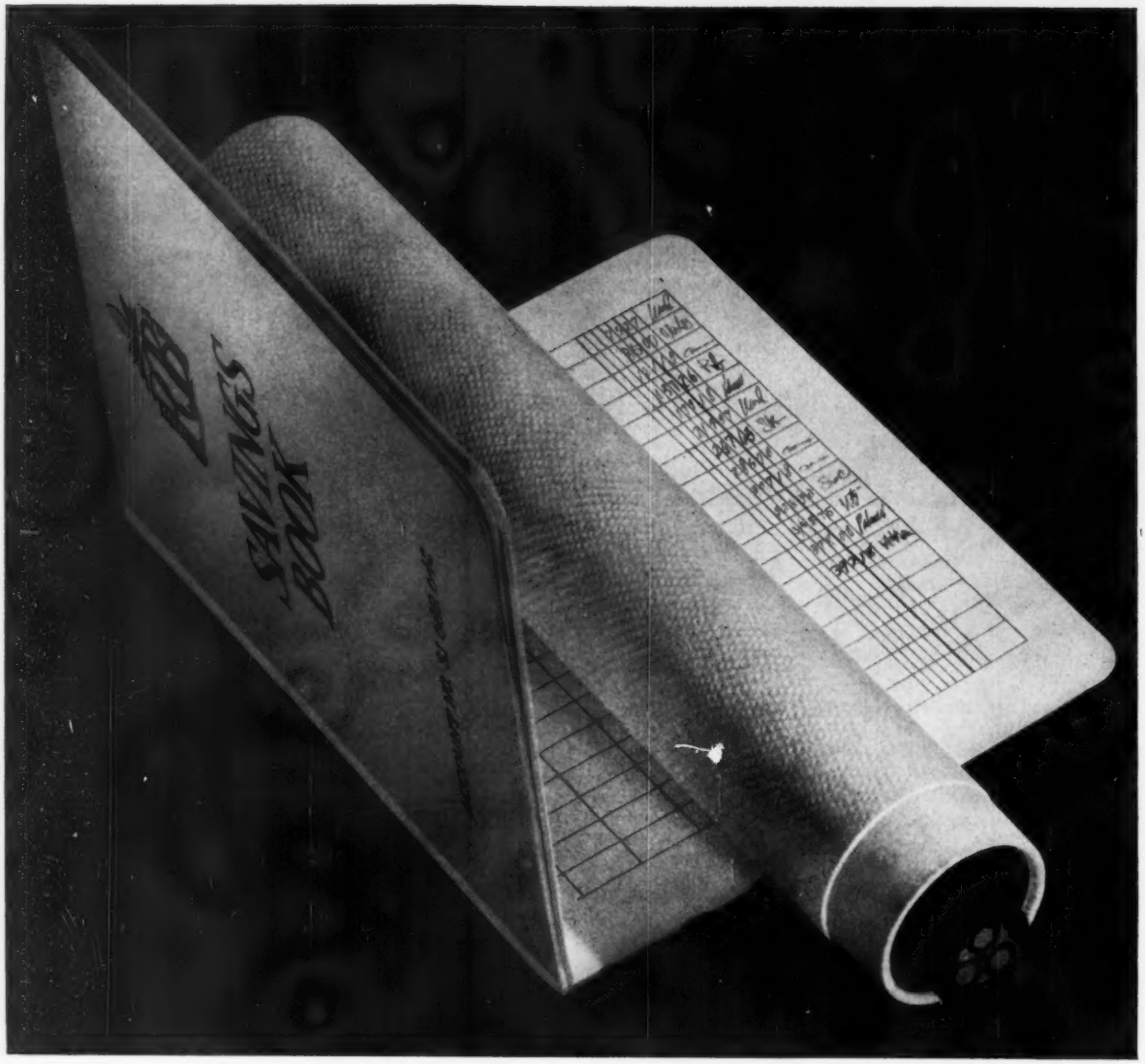
To learn how Greenlee tools assure extra efficiencies, better final results, *and more net profits,* see your Greenlee distributor . . . or write for Bulletin E-240A today.

GREENLEE TOOL CO.
1956 Columbia Ave. Rockford, Illinois

TOOLS FOR CRAFTSMEN
GREENLEE

JOB-PROFIT TOOLING

. . . cost control for contractors



Save on installed costs with Transite Electrical Ducts

To meet today's strict conduit specifications and, at the same time, keep installed costs down, more and more contractors are turning to Transite® Ducts.

Transite's long lengths and light weight reduce handling and laying costs. This, combined with a quick coupling method, permits rapid assembly. A small but complete line of fittings simplifies the assembly of duct-bank configurations even with complex constructions. Finally, the smooth inner walls of Transite make cable pulling easier—reduce strain on both the cable and pulling equipment as well as the duct. Result? Fast installation and a saving on every foot of duct you lay!

Non-combustible, non-sparking Transite resists corrosive soils, electrolytic action and stress of normal soil movement. Its tight joints are flexible yet permanent. They lock out water-borne silt, roots and other system disrupters.

For full details, write Johns-Manville, Box 362, ECM-10, New York 16, N. Y. In Canada: Port Credit, Ont. Cable: Johnmanvil.

JOHNS-MANVILLE JM

STOP WASTING TAPE

USE THE * FLIP-n-CUT® ROLL-SIZED TO THE JOB

NO. 7 SLIPKNOT PLASTIC TAPE

NO MORE WASTE — no more disappearing leftovers — when you use NO. 7 SLIPKNOT PLASTIC ELECTRICAL TAPE in the FLIP 'N CUT tailored to the job! NOW . . . because *you* asked for it . . . the FLIP 'N CUT comes in THREE handy sizes — 30′ — 44′ — 66′ rolls! Your Distributor has them right now!

*HANDIER THAN AN EXTRA HAND! That's FLIP 'N CUT®, Slipknot's exclusive dispenser-cutter that stores, dispenses and cuts the finest plastic tape you can buy. Ask for it by name!

SOLD ONLY THRU RECOGNIZED DISTRIBUTORS

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PLYMOUTH RUBBER COMPANY, INC.

QUALITY SINCE 1896 CANTON, MASSACHUSETTS

Floodlight test equipment.

It shouldn't be, of course. But it is.

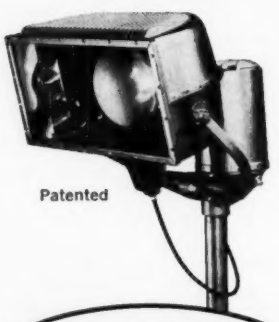
Unfortunately, when you put a floodlight up on a pole, somebody is going to try to find out how much punishment it can take. That's one of the reasons we build Wide-Lites the way we do.

The tempered glass lens, for instance, does more than keep dust, dirt and moisture away from the reflector. It also *protects* the lamp and reflector from everything but the best-armed vandal. Strong enough to withstand hammer blows, the Wide-Lite lens can shrug off the average BB shot and most objects that can be thrown to floodlight height. (Rear-guard protection for the reflector is taken care of by the rugged die-cast aluminum Wide-Lite body.)

A hot floodlight lamp should be protected from *nature's* vandalism, too—from the sudden shock of ice cold rain and sleet. Naturally the Wide-Lite tempered glass lens resists such thermal shock. Resists it so well, in fact, that no Wide-Lite lens has ever cracked or broken from thermal shock.

In short, the Wide-Lite lens is built to stay put. Even when relamping. (A special access plate makes it easy to relamp without disturbing the lens seal.)

Why not find out all the other things that make Wide-Lites so provably better? Write today for more facts. Wide-Lite Corporation, Division of Esquire, Inc., Dept. VA-111, 4114 Gulf Freeway, Houston 1, Texas.



HIGH EFFICIENCY FLOODLIGHTS

Pays for itself fast . . . in labor savings alone!

RIDGID® 535 PIPE & BOLT THREADING MACHINE

A Complete Pipe and Conduit Workshop At Your Finger Tips . . . For High-Speed Threading, Cutting, Reaming

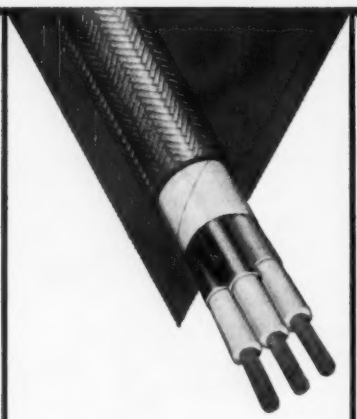
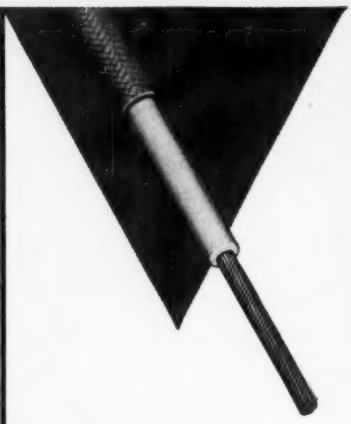
Full 2″ capacity. Plenty of power for up to 12″ geared tools. Universal Die Head included threads ½″ to 2″ pipe and conduit with just two sets of dies. Four other styles of heads available . . . ⅛″ to 2″ pipe or conduit, ¼″ to 2″ bolts. Fast hand-action RIDGID Speed Chuck. Cam-Action Rear-Centering Workholder. Automatic re-circulating oil system. Easy-to-Read Length Gauge.

See and Try This Time and Cost-Saving RIDGID 535 at Your Supply House Today

RIDGID

THE RIDGE TOOL COMPANY, ELYRIA, OHIO, U. S. A.

Rockbestos Silicone Rubber

	 POWER CABLE	 CONTROL CABLE	 APPLIANCE and FIXTURE WIRE
Voltage	600 and 5000 volt	600 volt	300 and 600 volt
Operating Temperature	125°C	125°C	150° and 200°C
Size Range	600V: #14 AWG to 500,000 CM 5000V: #8 AWG to 500,000 CM	#14 — #9 AWG	150°C: #22 to #18 AWG — 300 volt #22 to #10 AWG — 600 volt 200°C: #18 to #12 AWG — 600 volt
Construction	**Conductor** — Tinned copper, stranded **Insulation** — Silicone rubber **Covering** — Asbestos braid	**Conductor** — Tinned copper, stranded **Insulation** — 3/64ths silicone rubber, glass braid, color coded **Covering** — Cable tape, asbestos braid. Also available in galvanized steel, aluminum or bronze interlocked armor	**Conductor** — Tinned or nickel plated, stranded or solid **Insulation** — Silicone rubber **Covering** — Glass braid
Applications	Power wiring in high ambient temperature locations. Allows the most efficient utilization of the conductor. Satisfactory for installations in wet or dry locations.	Recommended where control or signal circuits are exposed to high ambient operating temperatures... steel mills, power stations, automotive, cement and glass plants.	For wiring of high wattage units, such as lighting fixtures, clothes dryers, sun lamps, stoves, electronic equipment, water heaters, ovens, and other apparatus.

Wire & Cable Selector

APPARATUS and MOTOR LEAD WIRE	LIGHTING WIRE
600 volt	600 volt
200°C	125°C
#20 to 4/0 AWG	#14 to #8 AWG
Conductor — Tinned copper, stranded **Insulation** — Silicone rubber **Covering** — Glass braid	**Conductor** — Solid tinned copper **Insulation** — Silicone rubber **Covering** — Glass braid
For leads to motors and transformers in high temperature locations. Stands up excellently under varnish dip and bake processes.	For lighting circuits in high ambient temperature locations.

Rockbestos Silicone rubber cables give you these outstanding advantages:

- excellent heat resistance 125°C-200°C allowable conductor temperature
- flame resistant—slowly forms non-conducting ash maintaining circuit integrity
- corona and ozone resistant
- maintains flexibility from —130°F to +500°F
- excellent resistance to oil, solvents, fuels and chemicals
- excellent electrical properties

ROCKBESTOS WIRE AND CABLE CO.
division of CERRO CORPORATION
Nicoll and Canner Sts., New Haven, Conn.

Gentlemen:

I would like to know more about the unique advantages of Rockbestos Silicone Rubber Wire and Cable. Please send me the following:

- ☐ The Rockbestos Silicone Wire & Cable Catalog.
- ☐ A sample of your silicone rubber wire.
- ☐ Please have distributor or salesman call.

Name_____

Company_____

Address_____

Here's money-saving news about 40-watt fluorescents from General Electric

It's the brightest 40-watt cool white fluorescent ever made. With the General Electric NEW F40 you give your customers a 7% bonus in light at *no extra cost.* This extra light is worth 15¢ to 30¢ to most users. Yet the price of this lamp is the same as for ordinary fluorescents that give less light.

Now you can increase present lighting levels without charging a customer a single extra penny for lamps, fixtures or electricity. If you're putting in a new installation, you can give him the light level he wants with fewer lamps and fixtures.

General Electric scores another first in offering your customers this bonus in standard 40-watt "white" fluorescent lamps. The G-E NEW F40 is rated at 3100 lumens in popular cool white, 3250 in white or warm white. That's because of three light-producing G-E Premium 3 construction features available for the first time in a lamp that sells for the same price as ordinary fluorescents—only $1.30 for cool white, $1.35 for other "white" colors:

1. G-E wattage-miser electrode helps convert power ordinarily lost in the cathode into useful light—free.
2. New, more efficient gas mixture.
3. New electronically screened bonus-phosphor.

NEW F40 is rated at 7500 hours in Rapid Start and starter-type circuits (6000 in systems installed before 1954). In pre-'54 circuits use F40/54 lamps. They give 7500-hour life, same light as ordinary 40-watt fluorescents (2900 lumens) at the same price ($1.30 cool white). General Electric Co., Large Lamp Dept. C-123, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW F40

ONLY $1.30 LIST

Only BURNDY offers all three!

THERMOWELD® — COMPRESSION — BOLTED

"Weld anywhere with lightweight THERMOWELD. Self-contained, needs no external source of power.

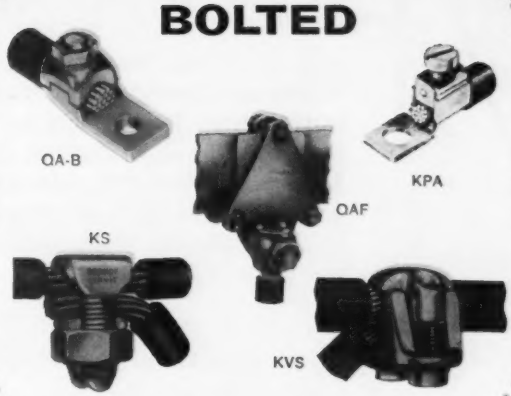
Pour powder into mold, tap. Starting powder won't mix with welding powder, assures positive firing.

Close cover, ignite with flint gun. THERMOWELD forms liquid copper which fuses conductors into solid mass.

Welds a permanent electrical connection easily and economically to any copper conductor or steel structure.

COMPRESSION

BOLTED



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BURNDY

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NORWALK, CONNECT. BICC-BURNDY Ltd. Prescot, Lancs., England In Europe: Malines, Belgium TORONTO, CANADA

LIKE AN EXTRA PAIR OF HANDS

IDEAL "WIRE-LUBE"®

Slides Wire Through Conduit, Makes Any Wiring Job Easier, Faster

Contractors agree, using Ideal "Wire-Lube" is almost like adding another helper on the job! Wires and cables **slip** through conduit, around bends and through tight spots. "Wire-Lube" takes the fight out of rubber, lead or plastic wire and cable, forms a slippery film to protect insulation against breaks, strains, and scrapes. Quickly applied by hand or brush, "Wire-Lube" dries to a fine lubricating powder that makes adding or removing wires easier later. Non-corrosive, non-combustible, and harmless to hands or clothes, it can be used in steel, aluminum and fiber conduit. Not suitable for asbestos-covered wire. One quart cans to 55 gallon drums.

And to make wiring easier still...

IDEAL STEEL FISH TAPE AND REEL

—flat oil-tempered spring steel simplifies wire pulling, won't break, kink or fray. Steel reel gives firm grip and extra leverage to push or pull tape through conduit—without strain. Also serves as container—keeps tape from springing loose—protects hands. Economical lengths of 50, 100 and 200 feet in ⅛" and ¼" sizes.

IDEAL ROUND FLEXIBLE LEADER

—music wire spring wound around a 20" airplane cable "smoothes out" tricky curves, guides fish tape into outlet boxes and around 90° bends, yet is tested to withstand 400 lb. pull. Attaches instantly to Ideal Fish Tape, handles up to six No. 10 wires.

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS • In Canada: Irving Smith, Ltd., Montreal

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for free Contractor and Electrician Catalog giving details on all Ideal Electricians' Equipment

IDEAL INDUSTRIES, INC., 1041-J Park Ave., Sycamore, Illinois (IDEAL)

Name_____

Company_____

Address_____

City_____ Zone____ State_____

61ST YEAR • OCTOBER 1961

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Arbitrary Roadblocks

From time to time we all see attractive contemporary building construction that should, in all reason, include relatively advanced mechanical and electrical features, but which turns out to be quite sternly conventional in its technical appointments. The facade belongs to tomorrow but the lighting belongs to yesterday.

In many cases, if we follow a building project from the owner's decision to build down through the exceedingly complex procedures of practical construction, we find roadblocks to the consideration of advanced technical features arising arbitrarily out of a compelling need for systematic order. Few, if any, individuals in these times can comprehend the full spectrum of architecture and construction technology in detail. The result is that practical construction is planned and executed by teams of specialists each with his own area of jurisdiction and priority.

The administrator must, from the beginning, proceed with an orderly sequence of firm decisions which progressively limit later considerations. Such decisions, even though they may be disappointing to a particular specialist, are usually respected and rarely challenged. A case in point is the application of electric heating. Conventional contemporary architecture for commercial buildings runs to excessive fenestration and simple wall sections of high conductivity, the least favorable condition, competitively, for electric heat. By the time the project reaches the electrical engineer, he may be boxed in by the owner's acceptance of the architect's preliminary sketches and the mechanical engineer's recommendations for a routine fuel-fired heating installation.

Another arbitrary roadblock arises from the most common guide to critical judgment employed by owners, that is, the least costly alternative. There is no more difficult task in building design than appraising alternative projects in terms of performance and value. It is part of the genius of outstanding architects and engineers that they are able to make such appraisals with imagination and foresight, and to convey to their clients the advisability of accepting advanced systems and features that may be significantly more costly than conventional alternatives.

It ought to be easier for owners to buy advanced electrical facilities such as up-to-date lighting performance, sophisticated electric heat or centralized building control and surveillance. But how rarely are they even proposed? It seems to us that it would be in the elementary self-interest of professional firms to propose technical features of respectable merit to their clients for possible consideration even though they may be more costly.

It might be unusual, but hardly unprecedented, to advance the broad exploration of critical technical features to the same schedule level as the preliminary construction plans. And it is becoming increasingly apparent that simultaneous concurrence on power, lighting, heating and air conditioning is practically essential. It is quite possible that much of our contemporary construction would be better equipped today if the best informed technical specialists were in on their projects from the earliest preliminary studies.

Wm. T. Stuart

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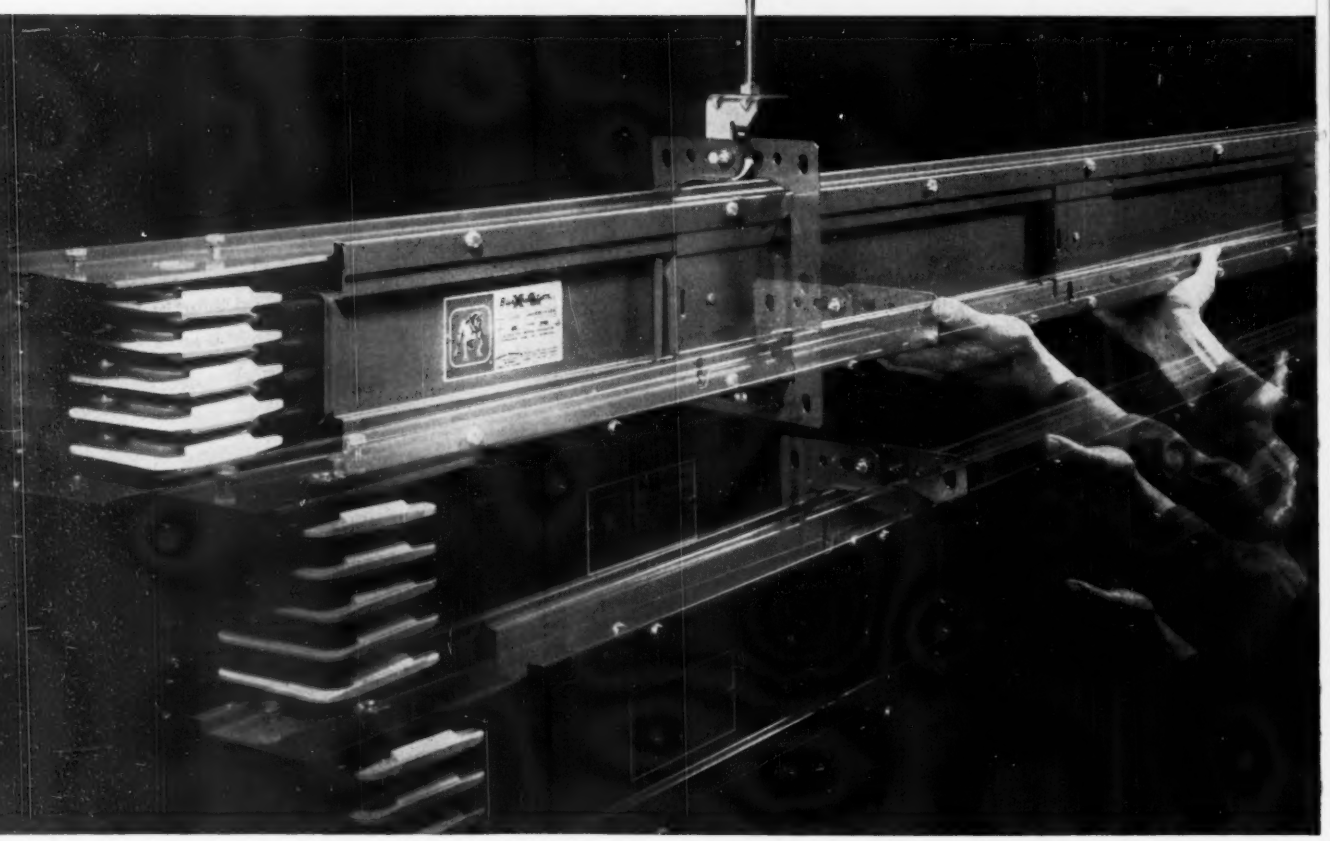

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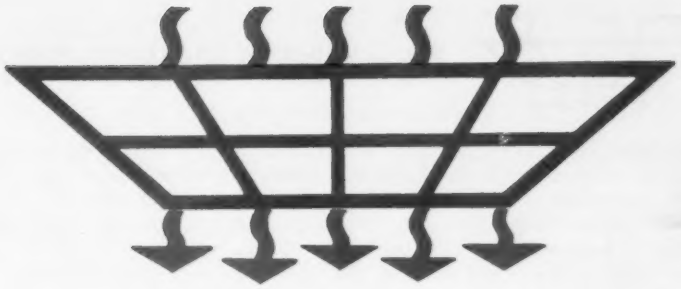


SOLVING PROBLEMS OF HEAT IN LIGHTING

Heat in lighting systems is increasing, as higher lighting levels are installed to meet growing demand for better visual environments. This, plus other problems resulting from current trends in building design, is taxing capacities of conventional cooling systems, creating need for new methods of heat transfer and total energy distribution within building structures. These problems, and some of the new methods for removing heat from lighting systems, are discussed herein.

By Berlon C. Cooper

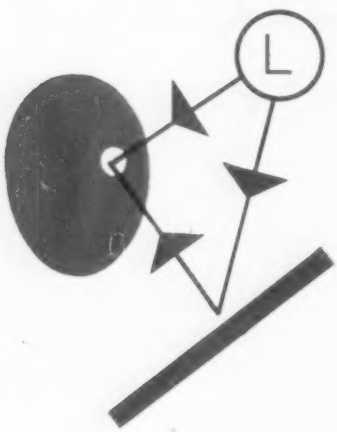
CONSIDERABLE progress has been made in building design over the past few years, but generally this progress has been in structural design and features, and in the use of new building materials. More recently, under pressure from building owners, greater attention is being given to interior design—to space flexibility, and to improved space environment. Space flexibility is needed to meet constantly changing requirements of building occupants. And controlled environments — visual, thermal, acoustical, esthetic—are needed for the comfort and well-being of the occupants.

The technology and the equipment to provide all these features are available. In practice, however, it is conventional to provide each feature with a separately designed and completely independent system. Thus, as is well known within the industry, building designers are faced with the ever-growing problem of where to put all the mechanical equipment involved in all the various systems. Compounding the problem is the trend to higher lighting levels, with the inherent increase in the lighting heat load. This higher lighting heat load, in turn, requires more cooling capacity. In many buildings, this added heat load taxes the capabilities of conventional air-conditioning methods.

Lighting and air-conditioning are two of the major elements in space-conditioning design. Recent developments include integrated systems for lighting-heating-cooling, and new methods for solving problems of heat in lighting. Many of these new developments and methods, including new equipments and new approaches to the problem, are discussed in detail on the following pages. It is believed that this timely presentation will be of interest to architects, designers and engineers alike, and may lead to even more sophisticated and economical thermal balance systems design for buildings, through the combined efforts of lighting, electrical and mechanical engineers.

PLANNED ENVIRONMENTS

DURING recent years a term that is relatively new to the building design and construction industry has come into use. The term is *environment*. This term is new only to the extent that, in the field of building design, it relates to the adaptation of enclosed space for human comfort and the well being of the occupants. There are variations of the term, depending on which segment of the building industry is using it. Some of the more popular terms currently in use are: *man's total environment, thermal environment, visual environment, acoustical environment, controlled space environment, engineered environment, planned environment*, etc. Other terms introduced recently, and relating to the same subject, include "Comfort Conditioning," and "Electric Space Conditioning."



The subject of "Built-In Lighting and Planned Environments" was covered in depth in a 17-page editorial feature in the October 1954 issue of *Electrical Construction and Maintenance*. This feature related to trends in lighting application techniques of that period which reflected the growing acceptance of built-in types of lighting design, and the need for intelligent integration of various modular design elements for desired environmental control. Lighting equipment manufacturers and lighting engineers were at that time giving new thought and attention to the creation of a pleasant luminous environment. Because of the growing acceptance at that time of luminous, or translighted, ceilings which extended from wall-to-wall, both manufacturers and lighting engineers were finding it necessary to also consider the problem of control of sound, the problem of heat in lighting systems, and air conditioning. For example, acoustical baffles which shielded the luminous ceilings, were designed as part of lighting systems to replace ceiling acoustical panels which had been replaced and in some cases also served as air supply outlets.

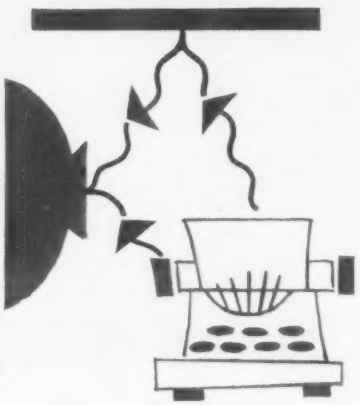
Today, with new lighting devices and new lighting techniques, some of the former problems have been solved, or eliminated. On the other hand, some of the problems remain, and some have increased. One such problem is that of "heat in lighting," which is of such importance to the continued growth of lighting that it has been selected as the theme for this editorial feature.

The need for planned environments is self-evident. The objective of a planned environment is a physically comfortable and esthetically pleasing interior area in which to live and work.

Vast strides in environmental control have been made recently—by scientists and by industry—and architects, designers and engineers have been alert to approve and create the kinds of environment people want and need to carry on their daily indoor activities and work most effectively.

Environmental planning hinges primarily on five elements—enclosure of space, climatic control, visual conditions, noise control, and a pleasing decorative effect. Thus these elements include physical, mechanical and psychological considerations.

Space enclosure relates primarily to structural design. Many factors are involved in its design, however. Its horizontal planes, the floor and ceiling, are fixed. Its vertical planes, or wall partitions, should be movable to provide for flexibility in floor space arrangements. In ceilings, acoustical, lighting and air conditioning elements should be integrated in such manner that any size space, as arranged by movable partitions, will be properly served by all three elements.

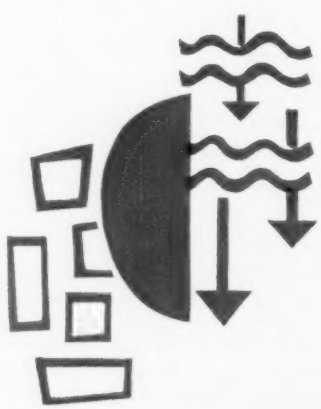


Climatic control involves heating, cooling, humidity control, air purification and elimination of odors, and possibly ionization of the air.

Visual environment is the lighting effect created by the lighting system, and includes lighting levels, brightness ratios for maximum seeing comfort, color quality of the illumination, and the elimination of direct and reflected glare.

Noise control of course relates to acoustical treatment of the enclosed space.

Finally, the appearance of the enclosed space must be pleasing, and is controlled by the colors and reflectance values of the floor, ceiling, side walls and furniture and decorative elements.



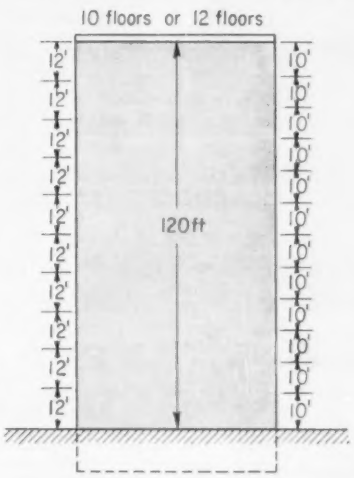
BUILDING DESIGN TRENDS

CURRENT building trends are the result of pressures from a number of varying factors. Always present is the factor of cost—over-all economy in first cost, and economy in operation. Several factors are at work, on the other hand, to increase building costs. One factor is the ever-present desire to build a creatively individual type building which usually (but not necessarily) costs more. Another is the constant impact of advancing engineering technology, in structural design, in new building materials, and in new and improved building products and mechanical systems, including heating, cooling, electrical distribution, lighting systems, etc.

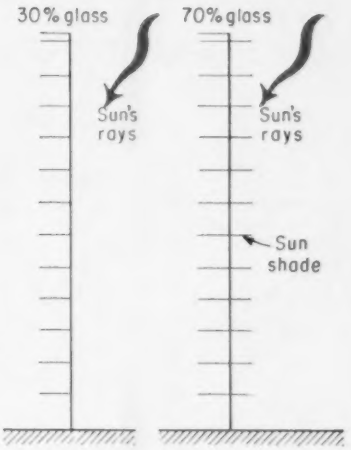
One recent trend in building design is the curtain wall type of construction, and the increasing use of glass in exterior walls. In practice, glass may vary from 20% to about 80% of the exterior wall area. Use of glass, while possibly desirable from an esthetic or design viewpoint, affects the size and design of the heating and cooling systems, and must be taken into account from an over-all building cost angle.

Buildings may be divided into two types, from the standpoint of this discussion. One is the commercially routine, or "speculative" type of design and construction, in which costs are usually at a minimum for the facilities provided. The other is the creatively individual, or "institutional" type of design and construction, often owner-occupied, in which more attention is given to design and appearance, and to the benefits and advantages of new and improved mechanical and electrical systems, lighting, and space environment.

How Much Usable Area in Structure?



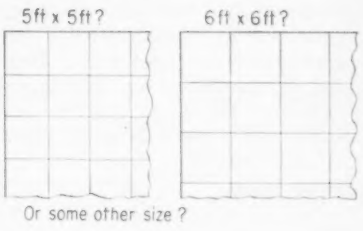
How Much Glass in Walls?



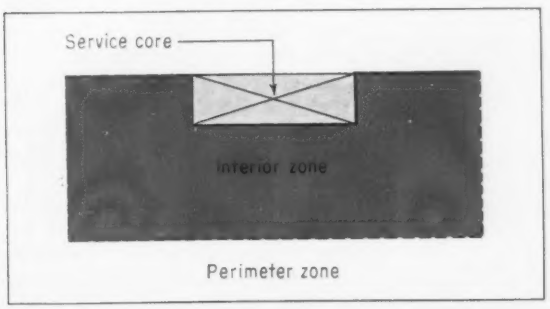
Another trend in building design is to plan the building around a mechanically independent module. This trend is an outgrowth of the need for space flexibility, and the necessity for providing all the elements required for the total environment of any enclosed space within a structure. In conventional practice, such environmental elements as acoustical, lighting, and air-conditioning systems each occupy a separate area on the ceiling. This practice is, of course, too cumbersome for complete freedom in space-use planning. Furthermore, space required for the mechanical equipments of these various systems when each is designed separately and independently, in the cavity plenum above the ceiling, increases beyond that considered as reasonable requirements. Economic considerations demand a vertical squeeze. Also, changes in space arrangements entail expensive revision to lighting and air distribution systems.

The mechanically integrated module made practical through the integration of lighting, acoustical, and air conditioning equipments, is helping to solve this problem.

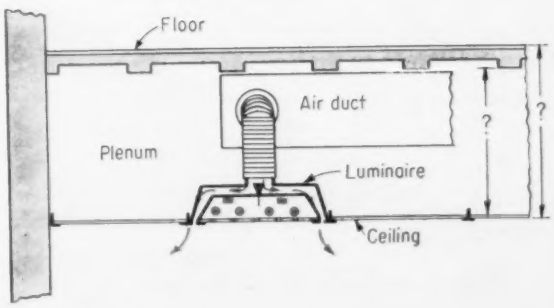
What Size Module?



How Much Space for Service Core?

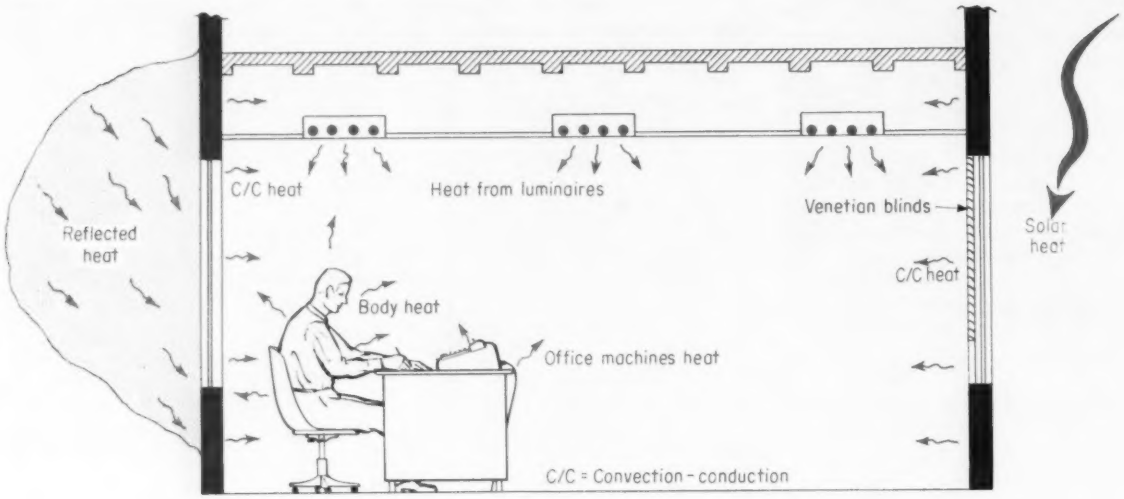


How Much Space for Plenum?



SOURCES OF HEAT IN STRUCTURES

Typical Sources of Heat in Building Structures



IN DESIGNING the heating and cooling systems for a building, it is necessary to calculate as accurately as possible the total heat load which will obtain in the building. In practice, this means taking into account the extremes of temperatures in the locality where the building is located, building orientation, type of construction used, the density of workers within the building, the lighting system, and other similar factors. This total heat load will enter into the calculations for determining how much heat is required for space conditioning in winter, or how much cooling capacity will be needed for summer.

In design practice, the building is divided into zones—outside wall, or perimeter areas, and interior, or core areas. In actual operation, and especially since the introduction of higher lighting levels, it is usually found that interior areas require cooling on a year-round basis, while perimeter areas require heating in winter, and greater cooling capacity in summer than is required for the interior zone.

Heat is measured in British Thermal Units (Btu). It is produced in buildings, as energy, primarily by the sun (through radiation and conduction), by people, and by electricity. Heat load is calculated by mechanical engineers based on charts and tables which have been prepared over many years, and well documented. Heating and cooling is the business of mechanical engineers who are specialists in this field. It is discussed here in general terms only, so that lighting and electrical engineers may better understand the impact of lighting and electrical heat loads.

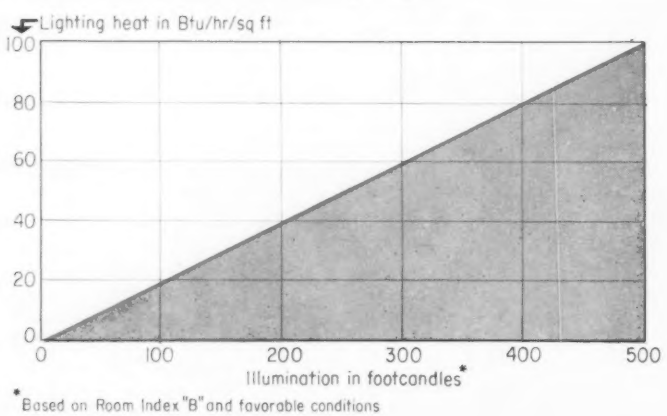
Solar radiation, conducted through walls and roof, is usually responsible for the major heat load in structures. Use of walls containing 50% or more glass area, compound the problem of cooling.

Heat from lighting systems varies with lighting levels and with types of light sources. Fluorescent lamps provide the highest efficiency, ranging from 60 to 80 lumens per watt. The chart (bottom left) shows Btu/hr/sq ft of floor area for fluorescent lighting, assuming a luminaire of 60% efficiency for areas with average favorable utilization conditions. For lighting levels in excess of about 75 footcandles, over-all economy dictates that fluorescent lamps be used.

People also produce heat. The average office worker, for example, produces about 220 Btu/hr. Each worker in the average office layout occupies about 100 sq ft of floor area.

Other heat loads include machines, electrical devices, and outside air brought in for ventilation and supply air to cooling systems.

Relation of Lighting Levels to Lighting Heat



*Based on Room Index "B" and favorable conditions

. . . In Light Sources

SINCE the adoption of so-called higher lighting levels by the Illuminating Engineering Society in 1958, many installations of 100 to 200 footcandles and above have been made. Thus considerable field experience in the use of higher lighting levels has been gained.

A major concern of the lighting industry when higher lighting levels were first announced was whether these new levels could be provided with visual comfort. Actually, most of these new installations have proved to be quite comfortable from a visual standpoint.

The major problem to come out of higher lighting levels has been the impact of the resulting higher lighting heat loads, especially on cooling systems. It is of such magnitude that it warrants the continuing study of lighting, electrical and mechanical engineers.

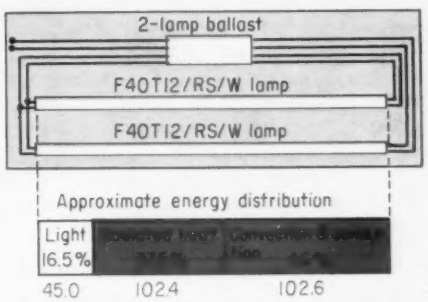
All heat in electric lighting springs from the electrical energy consumed by light sources and auxiliaries. Every watt of electrical energy consumed by a light source, or by a fluorescent lamp ballast, generates 3.41 Btu's of heat per hour. In conventional air-conditioning design practice, the total lighting electrical load is converted into Btu's and then into tons of air-conditioning capacity.

Since higher lighting levels can be obtained more economically with fluorescent lamps than with other available light sources, the basic 2/40-watt lamp and 2-lamp ballast light source combination has been selected for analysis and consideration throughout this report. The energy distribution for this basic combination is given in the above chart.

Light source efficiency is measured in lumens per watt. Thus it is possible to compare the heat output of different types of light sources for an equal light output. This has been done in Table I below.

Fluorescent lamps are designed to operate at maximum efficiency in still air at an ambient temperature of 77°F. If the ambient temperature changes, light output also changes. This relationship is shown in the chart below (left). The light output of fluorescent lamps is also affected by air drafts, either hot or cold. When bare fluorescent lamps are installed outdoors, such as under an exposed canopy, their light output drops considerably in cold weather, and in cold drafts. Conversely, when these lamps are installed in an enclosed luminaire in an ambient temperature of 70 to 80°F, the ambient within the luminaire rises as much as 40°F, and light output drops as indicated by the chart.

Energy Distribution for Typical 2/40-Watt Lamp Fluorescent Luminaire



	Watts	Btu/Hr.
Ballast* (watts loss)	12	41.0
Lamps** (2/40-watt)	80	273.0
Total	92	314.0

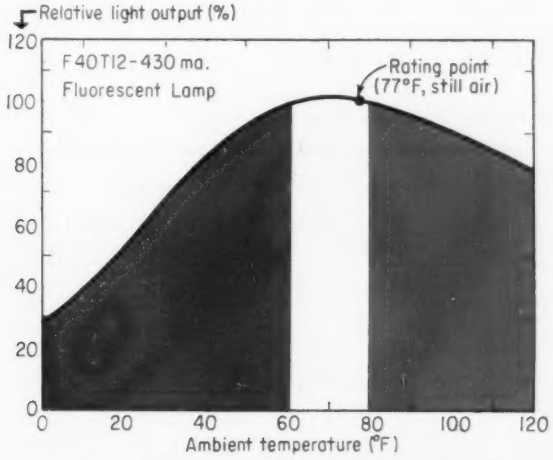
273.0 Btu/hr. for 2/40-watt lamps

*Based on General Electric Cat. No. 6G1020

**Light output of 3250 lumens each for white and warm white lamps; 3100 lumens for cool white lamps

Source: General Electric Co., Lamp Dept. Nela Park

Ambient Temperature Affects Light Output of Fluorescent Lamps



Source: *IES Lighting Handbook*, 3rd Ed., Fig. 8-45.

Light Source Efficiency Affects Lighting Heat Load

Table I—Heat per 1000-Lumens For Light Sources

(Used for General Lighting Purposes)

Type of Light Source	Lumens per watt (Range)	Btu/Hr/1000-Lumens (Range)
Fluorescent*	60–80	56–43
Mercury Vapor	40–54	85–63
Incandescent	17–23	200–148

* Lamp only, not including watts loss in ballast.

. . . IN LUMINAIRES

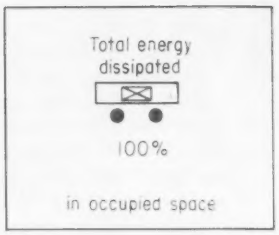
THE amount of heat produced by specific light sources and auxiliaries remains the same, whether operated in luminaires, or out. However, heat energy distribution varies with the types of luminaires, just as does light distribution. While heat energy distribution curves have not been developed for luminaires, such curves could be developed, and would be useful in analyzing problems of heat in lighting.

Shown at right are energy distribution values for two types of luminaires—"in-room" and "recessed-troffer" types. Using the basic light source component of two 40-watt fluorescent lamps and a 2-lamp ballast, if operated in an "in-room" luminaire, the total heat load of 314 Btu/hr would be dissipated in the occupied space lighted by the unit. However, if the same two lamps and ballasts are operated in a "recessed-troffer" unit recessed in the ceiling, only 28% of the energy would enter the occupied space, and the remainder (72%) would be confined in the luminaire. Since the luminaire is recessed in the ceiling, this 72% of the energy may be removed without being added to the air-conditioning heat load.

Energy Distribution for In-Room Luminaires

(Two 40-Watt Lamps and 2-Lamp Ballast)

	Total Energy	
	Btu/Hr	Percent
Ballast	41.0	13
Convection-Conduction	125.6	40
Infrared	45.0	14
Light	102.4	33
Total	314.0	100

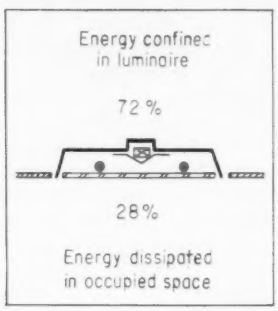


Energy Distribution for Recessed-Troffer Luminaires

(Two 40-Watt Lamps and 2-Lamp Ballast)

Energy Confined in Luminaire*	Btu/Hr	Percent
Ballast	41.0	13
Convection-Conduction	125.6	40
Infrared	41.0	13
Light	18.0	6
Total	285.6	72
Energy Entering Occupied Space		
Light	27.0	9
Infrared	61.4	19
Total	88.4	28

* Luminaire Efficiency = 60%

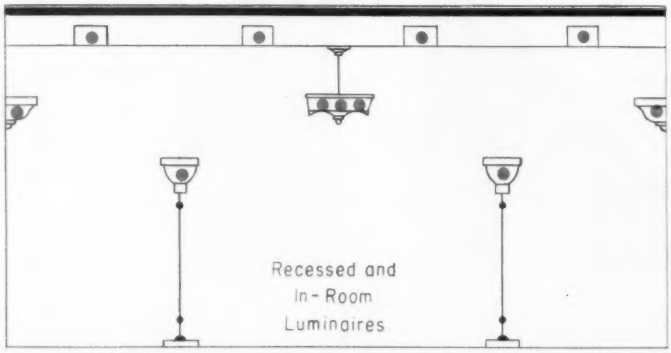


. . . IN LIGHTING SYSTEMS

BASED on the analysis given above for determining the energy distribution of specific types of luminaires, it is seen that a similar analysis can be made showing the quantity of lighting heat capable of being controlled in any type of lighting system. In the illustration at right, four different types of luminaires are shown. Three types are typical "in-room" luminaires, and of the type in which incandescent lamps are normally used. The lighting heat load from all of these units, equal to the total heat generated by them, would be dissipated in the occupied space and would all have to be removed by the cooling system. The fourth type of luminaire is a recessed troffer. Part of the energy dissipated by these units, which can be calculated based on the lighting efficiency of the unit, can be controlled separately from the system used to cool the occupied space.

In the above example, only a small part of the lighting heat generated would be available for control. But the analysis is nevertheless highly important in space conditioning design. It should be noted that if the plenum above the ceiling is not ventilated, or that if some method of removing the luminaire heat is not adopted, the heat will build up in the plenum and in the room until it enters the room at the same rate it is generated. Then the entire heat load must be handled by the cooling system.

Lighting Heat in Typical Lighting System



SPACE THERMAL CONDITIONING

IN ORDER to create a comfortable space environment in today's modern buildings, on a year-round basis, it is necessary to provide both heating and cooling. During winter months, or the heating season, cooling requirements are minor—needed for interior zone areas only, or not at all. During this same period, heat is usually required for all perimeter areas, and may be required throughout the building at times, especially during severe cold weather.

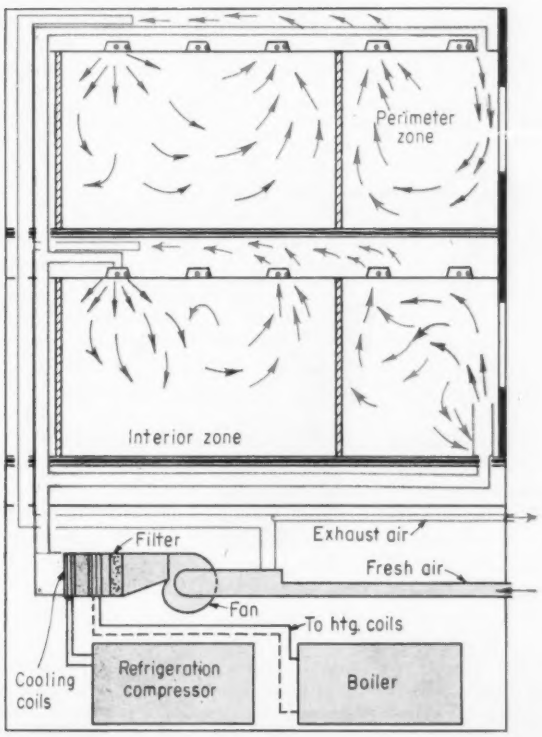
On the other hand, cooling will be required for all areas of the building during summer months, and may be required for some interior areas at all times.

As has been pointed out previously, there are several sources of heat in occupied buildings at all times. These include: body heat of people in the occupied areas, heat from lighting systems, heat from all devices which are electrically operated, and heat in fresh air brought into the building for ventilation, fresh oxygen supply, etc. Also, during sunny days, even in cold weather, solar radiation exists and is a major source of heat.

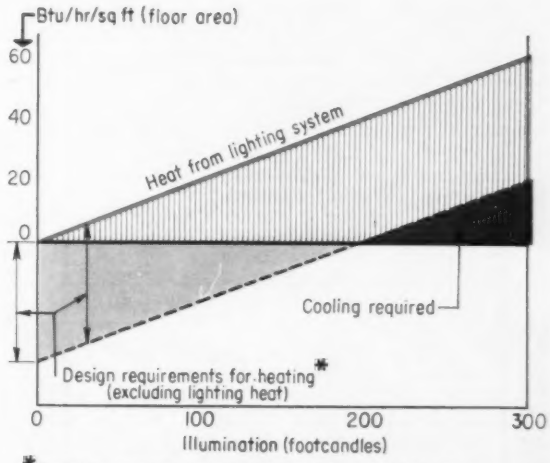
Conventionally, it has been usual practice for the heating engineer to calculate heating requirements for the coldest conditions to be expected, and to install heating capacity ample to satisfy the maximum needs for heat. Likewise, the air conditioning engineer has also independently calculated cooling requirements for the most severe conditions of summer weather, plus all other heat loads within the building, and has installed cooling capacity ample to meet these requirements. As a result, at certain periods during the year, and in some cases throughout the entire year, energy is being used to provide both heating and cooling at the same time, with some of the heat being dissipated to the outside of the building by the cooling system when the heating system is being used to provide heat for some areas of the building.

Since the adoption of higher lighting levels, with considerably higher heat loads from lighting throughout the year, many engineers have given more study to the economics involved, and some installations have been designed in which heat can be transferred from areas of the building which need to be cooled, to other areas which need to be heated. Another solution has been to store unwanted heat, as in hot water, for use when heat is wanted. What is needed is greater consideration to thermal load balancing, which can use lighting heat and help reduce both heating and cooling capacity requirements.

Comfort Conditioning of Space With Conventional Air-Conditioning System



Lighting Heat Can Supplement Heating System Requirements



*Prototype example; varies from building to building based on existing climatic and other variable conditions

SCHEMATIC showing simplified single-duct central heating and air-conditioning system, using moving air. Interior zone uses lighting troffers for supply diffusers and return air diffusers. Conventional linear diffuser over window on upper floor supplies conditioned air, while induction unit on lower floor under window supplies conditioned air.

Conventional Systems

NOT too many years ago, when building interiors became too warm, the occupants opened the windows and introduced moving air into the interiors. Thus, when cooling systems first came into being, it was only natural that they were based on moving air. Electric fans were first used, then systems were designed which cooled the air. Modern cooling systems are usually of the "all-air" or the "air-water" types. Through experience, the air-conditioning industry has learned how to "condition" the air so that it is comfortable. The air must not be too cold, too warm, too wet, or too dry. In other words, the temperature and humidity of the air is controlled. Also, air motion, or the number of changes of air per hour, is a factor in air-conditioning comfort. Experience dictates that, for comfort, the number of air changes per hour should not exceed 20, and that the temperature differential between the cooled input air and the air in the room should not exceed 20°F. These factors, therefore, establish limitations to the amount of heat an air-conditioning system can handle, and still maintain comfort for the occupants of the air-conditioned area.

In the conventional "all-air" system, cooling and dehumidifying is accomplished by distributing air from a central station to the conditioned spaces. This is done by several methods, such as by single-duct and double-duct systems. In an "air-water" system, air is used for ventilation and dehumidification, and cooling is accomplished with cold water, using induction systems, radiant cooling systems, etc. These systems are classified as high or normal velocity (air) and high or normal pressure (water). The basic heat load pattern for a specific building usually determines the kind of air-conditioning system which should be used, and is a design job for the mechanical engineer.

In the conventional cooling system, the cool air is introduced into the space to be conditioned through and air-supply diffuser, and exhausted from the area through an air-return outlet. In order that fresh oxygen may be supplied to the system, fresh air from outside the building is introduced to the central station, or cooling unit, and an equal quantity of waste air is exhausted to the outside of the building. With this type of system, all of the lighting heat load enters the occupied space and is handled by the cooling system.

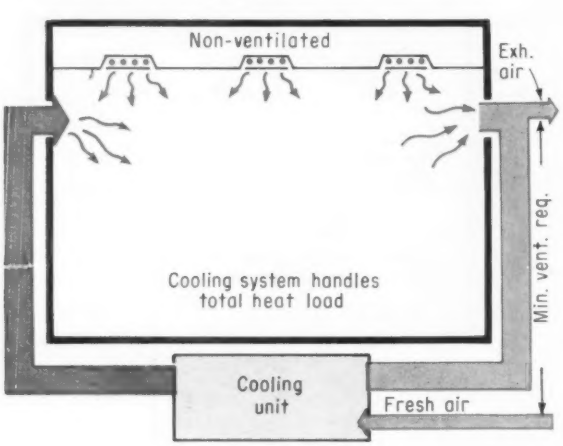
Table II—Comfort Factors in Air-Conditioning Design

Air Changes/Hr.	Temperature Differential	Reason for Exceeding Limits	Effect on Comfort
Up to 20	Not over 20°F	———	Comfortable
Not over 20	Up to 20°F	———	Comfortable
Over 20*	Not over 20°F	Increased heat load	Uncomfortable (Drafts, cold spots)
Not over 20	Over 20°F*	Increased heat load	Uncomfortable (Condensation)

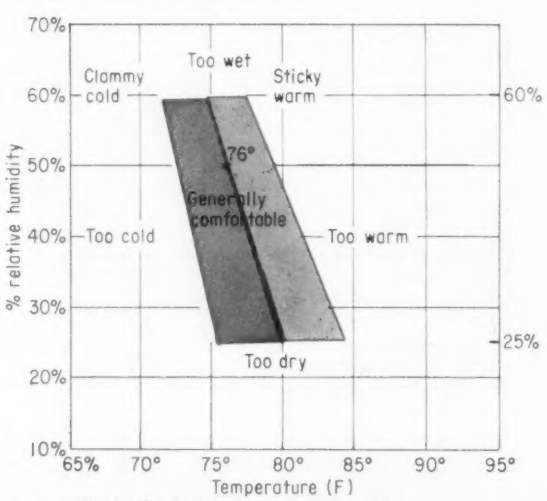
* Design limits exceeded.

Source: LIGHT magazine, Vol. 29, No. 1. Article on "Lighting and Air Conditioning Design," by W. S. Fisher and J. E. Flynn.

Conventional Cooling System



Indoor Climate Comfort Chart



Source: *Illuminating Engineering*, Volume LV, p. 354

Integrated Systems

ALL the heat load from higher lighting levels does not necessarily have to be handled by the cooling system. With some types of lighting systems, such as recessed troffers, luminous ceilings, louvered ceilings, etc., it is possible to keep part of the lighting heat load (conducted-convected heat) out of the occupied space in the room below the lighting system. In other words, much of the lighting heat (50% to 80%) can be controlled and kept out of the occupied space. This reduction of lighting heat in the room makes it possible to increase the lighting heat load, and lighting levels, and still maintain occupant comfort.

There are various ways of controlling that part of the lighting heat which can be kept out of the occupied space. Three examples are shown in the illustrations at right. There are, of course, many other methods, and variations of the examples shown. Each building and lighting system will present its own problems, and dictate the specific solution which is most practical and economical.

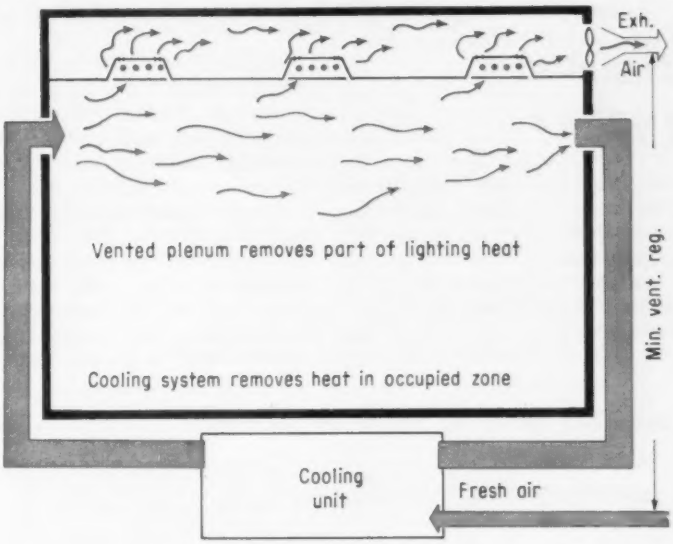
One simple solution for keeping part of the lighting heat load out of the occupied zone is to ventilate the plenum (illustration at top), or circulate return air from the occupied zone through and over the lighting equipment. If the plenum is kept sealed off from the occupied zone, outside air can be circulated through the ceiling cavity. This method would be practical only when the outside air is not greater than that of the nonventilated cavity. When the plenum is not sealed off, one solution would be to circulate ventilation waste air through the luminaires.

In the second illustration, the lighting and cooling systems are shown fully integrated. The recessed troffers shown are designed as "air-handling" troffers, and serve as diffusers for supply air or outlets for return air. In this case, cold supply air is distributed to the occupied space through some of the troffers, and warm return air is handled by other troffers connected to the return air duct. This system reduces the amount of lighting heat which enters the room and permits higher lighting levels to be used without discomfort to the room occupants, but it is obvious that additional lighting heat is added to the cooling system.

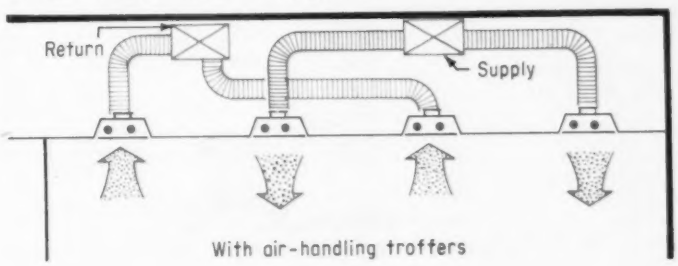
The bottom illustration shows a conventional air-conditioning system, using a conventional air diffuser. However, the return air from the conditioned space is circulated up through and over the lighting equipment before it enters the return air duct. In using this method, air should return through all luminaires and pass directly over the lamps for maximum heat transfer.

These three examples illustrate "integrated" lighting-cooling systems, which is one of the approaches to solving problems of heat in lighting.

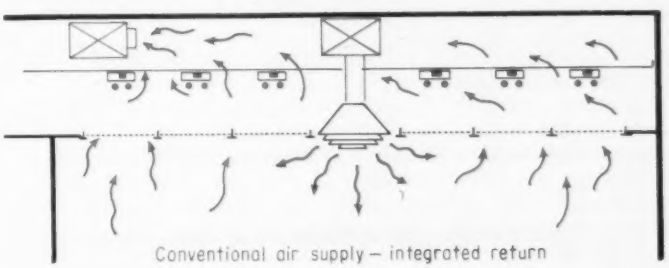
Cooling Plus Plenum Ventilation



Integrated Lighting-Cooling System



Return Air Removes Lighting Heat



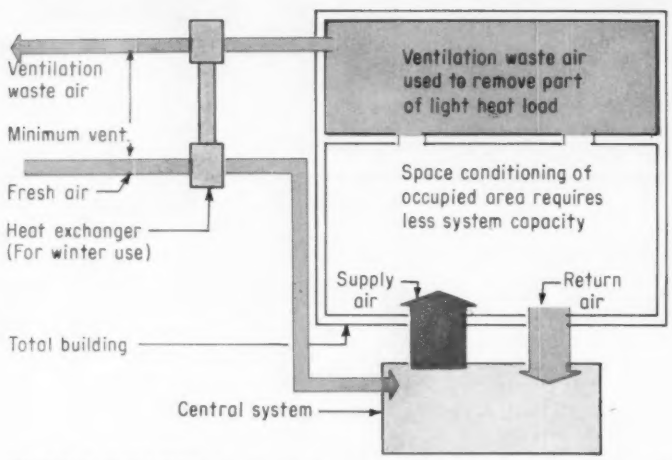
Integrated Systems (Cont.)

Integrated lighting-air conditioning systems have been developed, and are rapidly coming into use, for two basic reasons. The major reason, perhaps, is that by integrating these two systems, some of the conflict for space requirements between the two systems has been solved, or at least mollified. Through integration, clutter on the ceiling has been eliminated. Luminaires now produce lighting, and also serve as air supply diffusers or air return outlets.

A second, and possibly equally important reason for integrated equipment, is that integration of lighting units with the air-conditioning system has made possible the reduction of the impact of lighting heat loads on air-handling system capabilities. By removing some of the lighting heat load from the "comfort" zone of the occupied space, less air volume is required for control of the heat in the room, and the air which is used can be carried through a higher temperature rise which contributes to impoved system efficiency and greater thermal comfort. With less air volume to be handled, air ducts can be smaller, and plenum depth can be reduced. Also, with integrated systems, higher lighting levels are made practical on an economical basis.

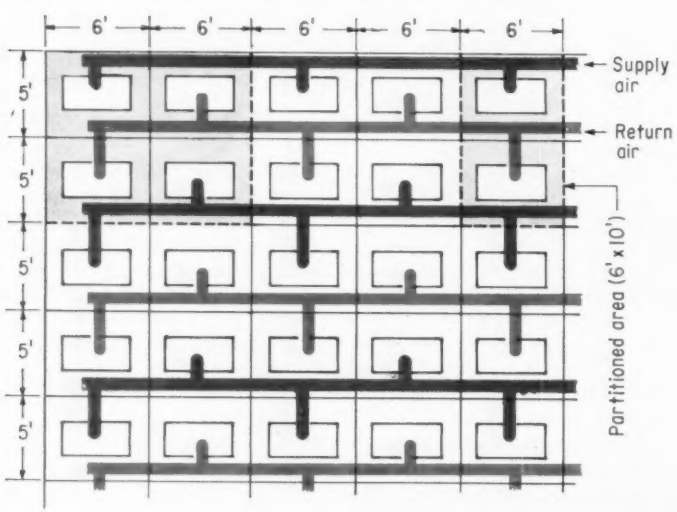
Notwithstanding the popularity of "all-air" and "air-water" cooling systems, the fact remains that, even with integrated lighting-cooling systems, the amount of space required for handling air efficiently and economically is costly and difficult to justify. Certainly here is an area which warrants much study and research work.

Integrated System for Year-Round Economy



COOLING CAPACITY for occupied area of a building can be reduced if ventilation waste air is used to remove part of the lighting heat load. For recessed and luminous ceiling lighting systems, up to about 80% of lighting heat can be removed in this manner. By means of a heat exchanger, the heat from this ventilation waste air can be reused in cold weather, with resulting year-round economies.

Integrated Systems Permit Full Modular Flexibility



Modular Flexibility

Modular design serves an important function in modern buildings, in providing maximum flexibility to space planning. And integrated lighting-cooling-acoustical systems make modular design practical.

Consider the illustration at the bottom of this page, for example. It shows a typical 5-ft by 6-ft structural module, and presents a typical lighting-air conditioning problem. From a space-planning standpoint, it is possible to use movable partitions to provide a 10-ft by 12-ft space, a 6-ft by 10-ft space, or any other similar arrangement.

From a lighting-design standpoint, a recessed 2- by 4-ft air-handling troffer can be installed in each module. By selecting either two, three, or four lamps per luminaire, a wide range of lighting levels can be provided.

From an air-conditioning design standpoint, alternate luminaires can be connected to the air supply duct, and the other luminaires can be connected to the return air ducts.

This combination of luminaires, air diffusers and air return outlets is such that any two or more adjoining modules are supplied with lighting, cold air, and air return outlets for complete lighting-cooling conditioning.

AIR-HANDLING TROFFERS

AIR conditioning is no longer considered a luxury, but a necessity, in modern commercial building structures. Its importance as an element of space conditioning is rated equal to that of lighting. And the trends in both air conditioning and lighting are to ever better systems, for maximum thermal and visual comfort.

Moving conditioned air has become the basic medium for heat transfer in buildings, and thus industry efforts to refine and improve cooling systems have been devoted primarily to refinements and improvements in air-handling methods and techniques. The most recent major development, although it has been under research and study for several years, is that of combination recessed lighting troffers and air supply diffusers. These combination units can serve as either air supply units or air return units. Thus they are aptly described generically as *air-handling troffers*. These units are the result of combined research and development work between manufacturers of air-conditioning equipment and devices, and of luminaires and lighting equipment.

. . . Side-Duct Troffers

Table III—Performance of Side-Mounted Air Diffusers

(With one diffuser per troffer)*

Capacity (cfm)		60	80	100	120	140
Static pressure ("w.g.)		.07	.13	.20	.29	.40
A-Sound level (db)		26	33	39	44	48
NC level (db)		19	26	32	37	41
Min.-Max. Diffusion Distance	Forward	3–10	5–12	7–13	9–14	11–16
	Spread	6–8	7–10	8–12	9–14	11–15

* For two diffusers per troffer, increase A-sound level and NC level two decibels.
Source: Anemostat Corporation of America.

Separate Air Diffusers Side-Mounted on Troffer

THE basic design of recessed lighting troffers is such that it has seemed practical to consider it as an air-handling device. Trends in building design, particularly to meet modular space flexibility and improved appearance of ceilings which were becoming cluttered with air diffusers, luminaires, sprinkler heads, acoustical materials, PA speakers and other devices, have thus spurred manufacturers of lighting troffers and of air-conditioning equipment, to give consideration to the troffer as a combination lighting and air-handling unit. Out of this has emerged the air-handling troffer.

Currently the air-handling troffer merely combines the luminaire and air supply or air return outlets.

Air-handling troffer developments to date have been made, in most cases, by the teaming up of a specific lighting equipment manufacturer and a specific air-conditioning equipment manufacturer. As a result, several different types of air-handling troffers have been developed. Four types—side-duct, single-shell, double-shell, and triple-shell—are discussed in this report. Each type has its own inherent advantages and disadvantages. Basically, however, the air-handling troffer is a progressive step forward in lighting and air-conditioning design, and will inevitably lead to further refinements and developments.

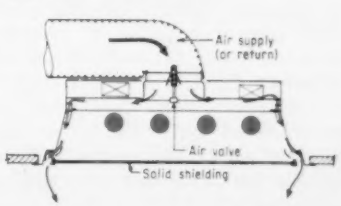
Side-duct troffers are basically standard lighting troffers to which an air diffuser is attached mechanically. The air diffuser is a special elongated device, complete with a self-contained air volume control lever, designed to attach to the outside of the troffer. The luminaire is special only to the extent that it must be of proper dimension for attaching the diffuser, and it must be equipped with an opening on each side which will accommodate the diffuser opening. Diffusers may be mounted on one side only, or on both sides, and may be used either for air supply or air return.

. . . Single-Shell Troffers

THE fundamental concept of the single-shell troffer, stated briefly, is that a basic troffer reflector, lamps and auxiliaries, and an air distribution chamber, complete with air valve assembly and louvered vanes running the entire length of both sides of the troffer, are combined in a single housing. It is classified as a low-velocity air diffuser unit, and features a coalescent air stream to the occupied area. In other words, as the air leaves the troffer, it coalesces into an air stream and penetrates through the warm used air at the ceiling level, bringing fresh, clean air into the comfort zone in the room below.

An interesting feature of air-handling troffers is that the fluorescent lamps operate more effi-

Integral Air Diffuser and Single-Shell Troffer



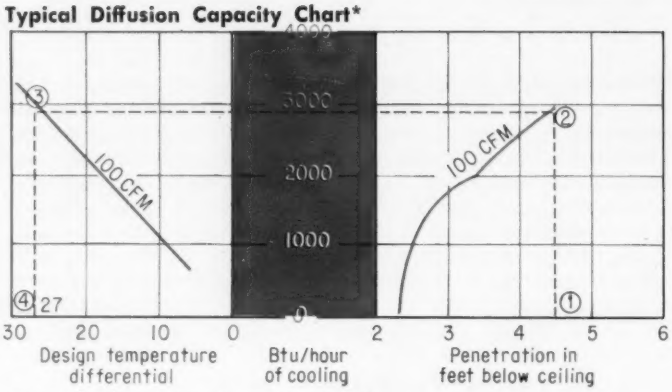
Single-Shell Troffers (Cont.)

ciently than in non-air-handling troffers. As pointed out on page 91, fluorescent lamps are designed and made to operate at maximum efficiency in an ambient temperature of 77°F (normal range of 70-80°F). This is the approximate operating temperature for lamps used in a bare-lamp luminaire.

Fluorescent lamps operated in the conventional troffer without air circulation cause the temperature in the lamp chamber to rise to as much as 120°F. Thus the light output drops. By using the troffer as an air-handling unit, some of the heat in the lamp chamber is removed, and the lamps operate in an ambient closer to their designed operating temperature. The relative light output in a typical 4-lamp 2- by 4-ft air-handling troffer is shown in the chart at right.

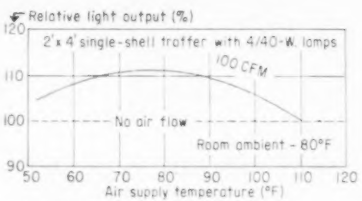
Air-conditioning design is a problem for the air-conditioning engineer. However, air-handling troffer manufacturers should supply complete technical data on their equipment. Both lighting and air-conditioning design must be integrated when using air-handling troffers. Thus technical data on the air-handling equipment is needed by both the lighting or electrical engineer and the air-conditioning engineer during stages of system design. Typical of the data required is that shown in the "Diffusion Capacity Chart" above (right). This chart is used to determine the number of air supply units required for an area. Curves are shown in the chart above for 100 cfm only. The manufacturer would provide curves for a range of cfm values. In order to use the chart, it is necessary to know the total heat load of the area to be air conditioned, and depth of the mixing zone (ceiling to comfort zone). In the example shown by dotted lines, for a 4-ft 6-in. mixing zone, using 100 cfm air supply, the maximum capacity of cooling is 2,930 Btu per hour per troffer. By dividing the total Btu load by 2,930, the number of air supply troffers needed is indicated. On the left part of the chart, the example used shows a design temperature differential of 27°F.

Typical Diffusion Capacity Chart*



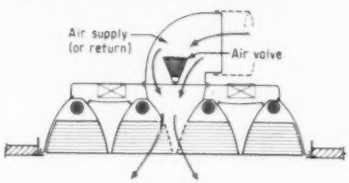
* For 2' x 4' troffer with solid shielding.
Source: The Pyle-National Company

Air-Handling Troffers Produce More Light



Source: Sylvania Lighting Products

Integral Air Diffuser and Parabolic Reflector Troffer



. . . Double-Shell Troffers

The double-shell troffer uses double-wall construction, and thereby completely isolates the fluorescent lamps and ballasts from the separate air chamber. Heat from the lamps and ballasts, plus light and infrared energy converted into conduction-convection heat within the unit, is removed by conduction through the metal reflector. By virtue of its double-wall construction, any type of shielding or louvering device may be used under the lamps without interfering with the air-handling characteristics of the unit.

The air distribution pattern of the double-shell troffer is angular. Its relative light output is above that of a static (non-air-handling) troffer throughout the normal ranges of cooling, or heating.

Manufacturers' technical data simplifies application design. Typical example of such data is given in Table IV on next page, which shows the maximum amount of air (cfm) that can be supplied to a room through one combination diffuser, for various ceiling heights and temperature differentials. The values given are based on acceptable comfort conditions for persons engaged in ordinary office work. Other design criteria include sound level and pressure drop, luminaire efficiency, etc.

In application, air-handling troffers may be used in either of three ways—1) as an air supply diffuser, 2) as an air return outlet (either open to plenum, or connected to the return air duct, 3) as a non-air-handling, or static, troffer. Experience dictates that it is desirable for all troffers to be "active," that is, handle either supply or return air. This insures that all lamps will

be operating at close to optimum light output, and that brightnesses of all troffers will be more nearly identical.

Air-handling troffers may be used for either cooling, or heating, subject to Underwriters' tests for heating under certain specified conditions. Certain types of light diffuser panels are not UL-listed, at this time, when the troffers are used for handling heating air. Manufacturers should be consulted for complete information on all proposed applications. As more and more of the initial problems are solved, manufacturers' literature will provide complete design and installation data.

Integral Air Diffuser and Double-Shell Troffer

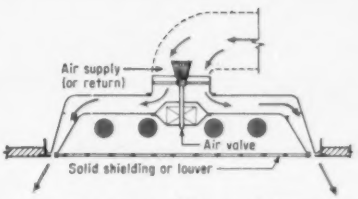


Table IV—CFM Capacity for Enclosed Double-Shell Troffer

T/D	Minimum Mounting Height			
(°F)	8 Ft	10 Ft	12 Ft	14 Ft
25	70	80	100	100
20	80	100	125	150
15	90	100	125	150
10	100	150	150	150
0	150	150	150	150

Note: Maximum CFM based on mounting height and temperature difference (°F) between room air and cold air supply at inlet to diffuser.

Source: Day-Brite Lighting, Inc.

. . . Triple-Shell Troffers

TRIPLE shell troffers consist essentially of a conventional troffer unit, to which has been attached a separate air chamber, with an insulating air gap separating the two. It is available with a choice of symmetrical air distribution patterns, either angular or horizontal. The diffusers can be used with either medium or high velocity air. From a theoretical design point of view, it is quite similar to a side-duct troffer.

Due to its construction, the relative light output of a triple-shell troffer handling cold air increases, over its light output as a static troffer, as the temperature of the supply air decreases, in a range from 100°F down to 50°F. In the range of cooling and heating temperatures normally found in the interior zones of most building structures, from 50°F to 70°F, the triple-shell troffer provides from 8% to 15% more light than a static troffer.

Fluorescent Lamp Color Shift

The color of a fluorescent lamp, like its efficiency, is also affected by its operating temperature. To obtain the true color of a lamp as designated, it should be operated in an ambient of 77°F, still air.

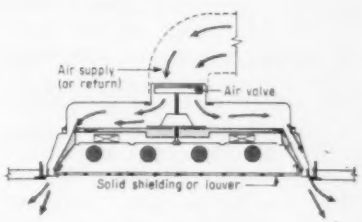
In conventional fluorescent troffer installations, the lamps are operating in ambient temperatures of around 120°F. As a result, the lamps are not providing their true designated color. However, this is not normally noticeable to the casual observer, since the color variation is uniform throughout the installation.

In air-handling troffers, and also in other integrated lighting-air conditioning installations, the ambient temperatures around the lamps are considerably lowered from that of conventional troffer systems. This changes the color of the lamps. Also, when lamps are located directly in cold drafts, color shift occurs. In some air-handling troffer installations, particularly on jobs where some troffers are static (non-air-handling) and others are handling air, color shift is noticeable. Thus, with certain types of air-handling troffers, all units should be "active," handling either supply or return air.

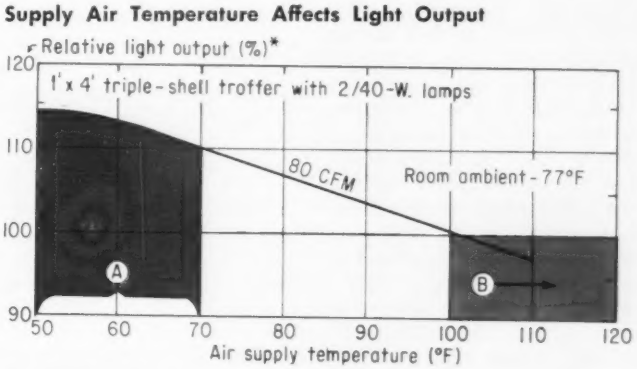
Experience has indicated that color shift occurs primarily with "warm" color fluorescent lamps—warm white, deluxe warm white, soft white, etc. Color shift is not apparent with cool white lamps.

When air-handling troffers are used on the heating cycle, a possible trouble is that of ballast overheating. Air-handling troffers undergo a very severe test for UL approval and listing for use on the heating cycle, and no trouble should be expected from units which carry Underwriters' listing. However, on other types of integrated lighting-heating installations, precautions against this possible trouble should be taken.

Integral Air Diffuser and Triple-Shell Troffer



Supply Air Temperature Affects Light Output



A - Normal supply temperature for cooling and heating used in interior zones of major building structures.

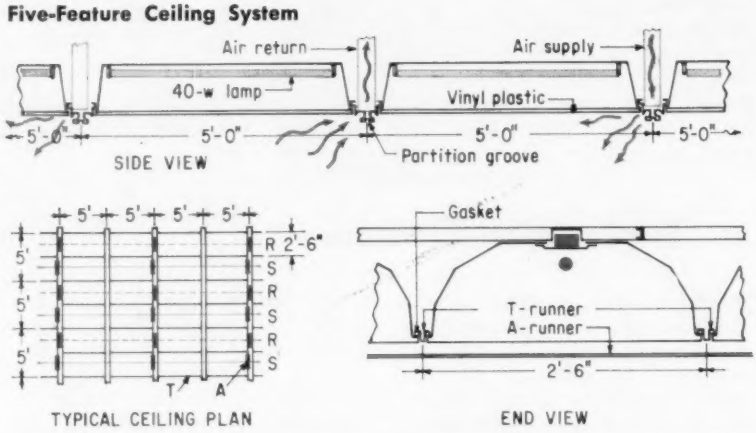
B - Supply air at temperatures in excess of 101°F decreases light output of this troffer below that of similar non-air-handling troffer.

*In percent of light output from same troffer with no air flow.

Source: Benjamin Div., Thomas Industries Inc.

. . . Full Modular Flexibility

Five-Feature Ceiling System



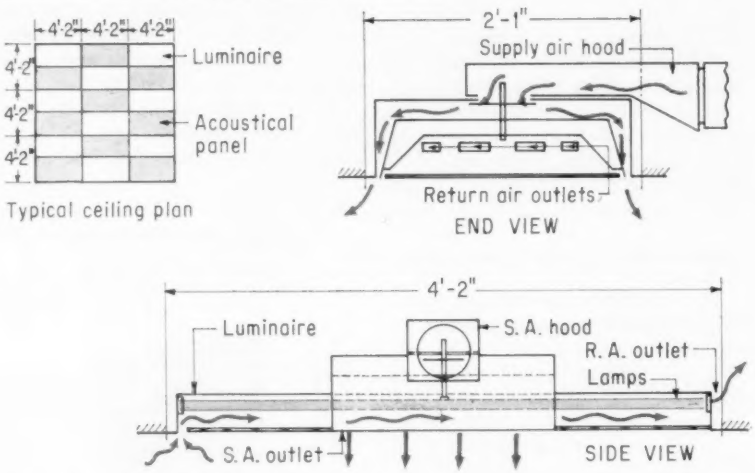
UNUSUAL flexibility in space arrangement and partitioning location has been provided in the new 52-story Union Carbide Building in New York City. This flexibility is made possible by a custom-designed ceiling system which integrates lighting, air conditioning, and sound control. The entire ceiling, which is a "plane of light," was custom-fabricated by a lighting equipment manufacturer, including the ceiling support system, air diffuser outlets and returns, lighting reflectors, sound barriers, etc., was specified in the electrical specification, and was installed by an electrical contractor.

This ceiling is designed on a module of 30 by 60 in., and partitioning can be installed on this same basis. From a lighting design standpoint, one 40-watt fluorescent white rapid start lamp is used per module, and a 2-lamp ballast serves two modules.

One ceiling runner is pierced for supply and return of air, and contains a partition groove. The other runner fits into the first, mechanically, and uses an adapter for partitions. Air supply and return is available for each 5- by 5-ft module.

. . . Triple-Function Luminaire

Combination Air Supply-Return Luminaire



SOME novel new ideas in advanced lighting and air-conditioning techniques have been planned for the proposed new 17-story office building of the Department of Water and Power in Los Angeles. Included is a triple-function luminaire which will provide light, and handle both supply and return air, all in one unit. The integrated unit, a basic 2- by 4-ft unit, will alternate with acoustical panels in a 4-ft 2-in. square module.

The luminaire will be an integrated recessed troffer, with provisions to supply conditioned air to the room, and to exhaust air through the same unit. The exhaust air will remove some lighting heat, generated by the lamp and ballasts, before it has a chance to enter the occupied space.

The heated return air will not be rejected. Instead, it will be reused, by means of a high velocity mixing box, to temper the cold supply air in proportions called for by zone thermostats.

Typical of conventional air-conditioning design procedure, the building will be zoned for perimeter area cooling, and interior area cooling. A heat pump system will provide both heating and cooling for perimeter areas, and cooling for interior areas.

The luminaire differs from the new type of air-handling troffers in that it handles not only supply air but also return air. Supply air will enter into the room through side diffusers on the troffer, controlled by an air valve, and warm used air from the room will enter one end of the troffer, flow through the lamp chamber over the lamps, and exit into the ceiling at the opposite end of the unit.

Source: *Architectural Record*, August 1961

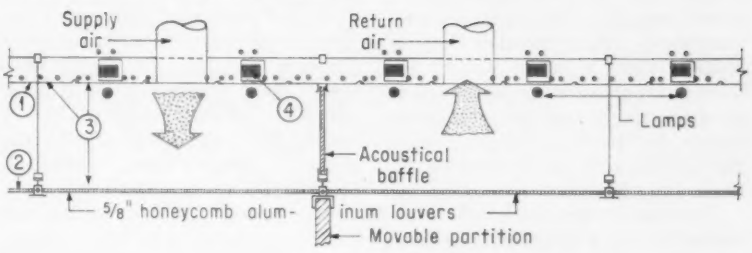
. . . Air-Water System

A RECENT research project, sponsored by Inland Steel Products Co., involved laboratory studies in which measurements of heat transfer and lighting characteristics of water-cooled radiant luminous panels were made. These tests have led to the development of an unusual and practical radiant-ceiling system for combined lighting and cooling. The integrated louvered ceiling system is shown at right. This ceiling can also be used with a standard cellular steel deck floor construction which provides header ducts for supply and return air.

The radiant luminous ceiling is arranged with an upper radiant ceiling panel integrated with the lighting strips, and a lower louvered radiant ceiling which is exposed to both the lighting heat load and the occupied space area heat load.

In the test installation, copper tubing was bonded to both the upper and lower radiant ceilings, as shown in the illustration above.

Water Removes Lighting Heat



1-Upper radiant ceiling
2-Lower radiant ceiling
3-3/16" copper tubing
4-Ballast

Source: *Illuminating Engineering*, August, 1961

In the proposed integrated louvered ceiling, the supporting tees would be water-cooled. Complete details of test are given in *Illuminating Engineering*, August 1961.

. . . Heating With Light

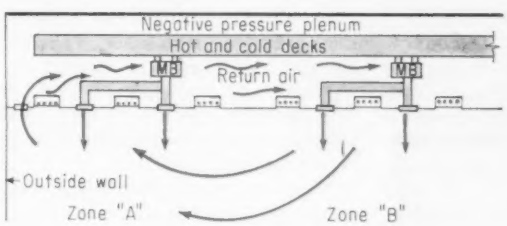
LIGHTING levels ranging from 100 to 250 footcandles throughout the building has made it possible to heat the new 22-story office building of Georgia Power Company, in Atlanta, Ga., with the heat from the lighting system. This has been made possible and practical through careful coordination of heating and cooling requirements. Key to this coordination was the use of hot and cold deck air chambers, from which either hot or cold air is supplied to thermostat-controlled air mixing boxes for distribution to occupied spaces. With thermostats located in occupied zones, temperature of the air supplied to the zone can be varied over a range from 53°F to 90°F.

In line with normal practice, the building floor area is zoned into perimeter zone and interior zone. This makes it possible to supply heat to the perimeter zone and cooling to the interior zone on the same floor at the same time, which it is necessary to do on cold days.

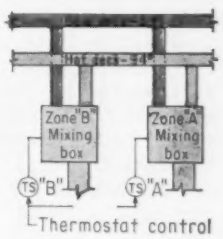
The lighting electrical load averages 90 kw per floor, and the typical floor contains 11,540 sq. ft. While this is adequate for heating the building to a design temperature of plus 10°F outside temperature, adequate for the Atlanta area, it was decided to install resistance electric heaters for heating the building at night in cold weather. These were installed under the windows of the outside offices, and in the hot air ducts.

Lighting in typical large office areas is by means of 4-lamp continuous-row 24-in. wide recessed troffers, installed on 6-ft centers. This provides 150 footcandles. In some areas these continuous-row troffers are on 4-ft centers, and provide approximately 225 footcandles. As shown in the elevation, above, return air flows through return grilles near the outside walls, and through the ceiling plenum to either the hot deck, or to an exhaust outlet. This return air picks up heat from the recessed troffers as it moves through the plenum, and thus keeps it out of the occupied zone. Thermostats turn on electric heaters at night, as needed.

Lighting Heat is Used to Heat Building



SECTION THROUGH PLENUM



MIXING BOX DETAIL

Source: *Illuminating Engineering*, June 1960

TRENDS IN SPACE CONDITIONING

MODERN lighting application spreads over a broad range of lighting methods and techniques, and involves hundreds of types and sizes of light sources, luminaires and lighting equipments. This is as it should be. Only through such an approach to lighting design can the current demands for more and better light, for utility and for decorative effects, be achieved.

This report, devoted to the problem of heat in lighting, has been related primarily to recessed types of luminaires and lighting systems. This has been done deliberately, since these types of lighting systems are of such structural design and nature that they can be integrated practically with cooling and heating systems. The problem of heat in lighting exists, however, wherever electric lighting is used. This report should, therefore, be of interest to all lighting engineers and designers, specifiers, sellers and installers of lighting systems, or related air-conditioning and heating-system designers who are concerned with the problem of heat in lighting.

Space conditioning, as used here, involves the over-all interaction and combination of the many factors needed in the creation and control of total planned environment. Such environment can only be achieved through the integration of the mechanical, electrical and structural systems. The selection and design of each must be developed simultaneously. With today's technology and equipment, virtually any environment can be created, and controlled with precision. This is now possible, however, only through the costly and impractical use of these systems designed independently of each other. What is needed is for the design of all three systems (mechanical, electrical, structural) to be considered as a single problem. This means the further integration of building systems and building products, and greater coordination of design by architects, designers, and engineers.

As has been pointed out in this report, some progress in space conditioning has already been made, and trends point to continuing progress. Many new buildings are designed around mechanical modules, which provide for space flexibility economically. Integrated lighting and air-conditioning systems are now available, which improve ceiling appearance, and result in some savings in space. Heating systems are also beginning to be integrated with combination lighting-cooling systems, with resulting economies through the use of lighting heat to supplement normal heating requirements. Continuing research and development work in this field will inevitably lead to new solutions to the over-all problem of space conditioning.

What of the future? In what areas are new developments possible which would lead to further space conditioning progress? Some of the areas which would seem to warrant further study and considerations are presented below.

• **Thermal balance**—As has been pointed out in this report, buildings have to be heated and to be cooled. A combination system which will utilize the unwanted heat load and provide thermal balance at all times would make possible new efficiencies (see "Economical On-Site Electric Generation," *EC&M*, June, 1961).

• **Economical heat transfer**—Conventional cooling systems depend primarily on moving air for heat transfer. Air-moving systems require extensive space for ductwork, mechanical and electrical equipment. Water is over 200 times as efficient as a heat-carrying fluid as air (see "Air Conditioning for Large Office Buildings," *Architectural Record*, October, 1960). It would seem that some more efficient method of heat transfer might be developed using water, or some other suitable liquid, as a cooling system for the entire building. It may also offer possibilities for removal of lighting heat only.

• **More efficient light sources**—The efficiencies of light sources have been increasing constantly through the years. Future increases may certainly be expected, which will help to solve the problem of heat in lighting systems.

• **High frequency power**—Fluorescent lamp efficiency is improved when lamps are operated at frequencies higher than 60 cycles, and ballasting requirements are negligible. This means more light with less heat. However, currently available frequency converters are not sufficiently efficient to warrant their general use. What is needed are more efficient frequency conversion units.

• **Thermoelectric devices**—When direct current is passed through two dissimilar metals in one direction (such as bismuth and antimony), their junction is cooled. When the current is reversed in direction, the junction is heated. This principle may provide the basis for an entire new approach to heating-cooling problems.

ACKNOWLEDGMENT

The author gratefully acknowledges the help and assistance of the many lighting and air-conditioning industry people with whom the subject of "heat in lighting" has been discussed over the past many months. This article has been based on the ideas and suggestions resulting from these discussions, and on technical data, supplied by some of the leading authorities in the field of integrated lighting-cooling-heating. The author is particularly grateful to the following individuals, who supplied the material and technical data on which many of the illustrations have been based: Benjamin S. Benson and Robert Geocaris, Benjamin Lighting Division, Thomas Industries, Inc.; William V. C. Foulks, Curtis-Allbrite Lighting, Inc.; R. D. Bradley and Murray L. Quinn, Day-Brite Lighting. Inc.; John E. Flynn and Will S. Fisher, Large Lamp Dept., General Electric Co.; J. M. Johnson, The Pyle-National Co.; and George W. Clark and Ray Corwin, Sylvania Lighting Division, Sylvania Electric Products Inc.

Design and construction details in . . .

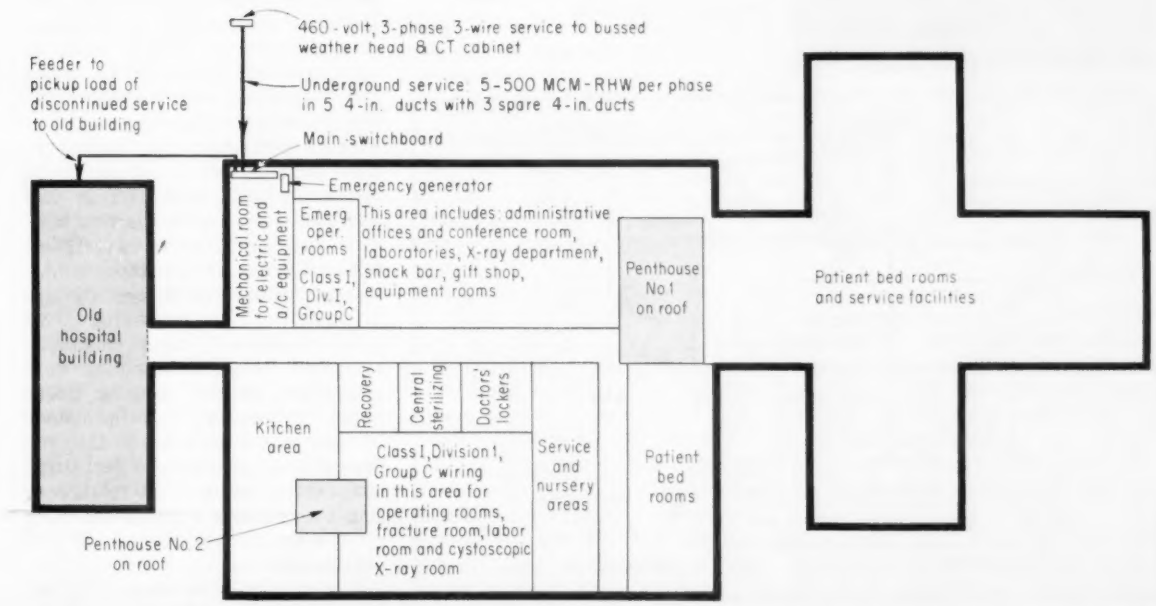
Modern Hospital Electrification

Here's how a 460-volt distribution system serves widespread light and power loads in a Houston hospital. Features include: all-electric kitchen, electrically operated beds, TV distribution system, modern nurse-call and efficient wiring in operating rooms through two-stage transformation—installed by Howard P. Foley Company.

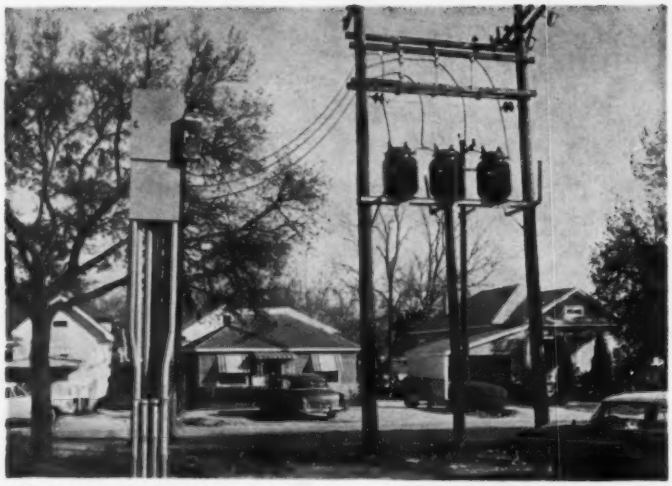
By Dowell Weeks, *Electrical Engineer*
Bernard Johnson and Associates, Houston, Texas

ELECTRICAL utilization is truly a vital element in operation of the new Houston Negro Hospital. Here, hospital facilities—ranging from cooking equipment and intercommunication to so small an item as a baby-bottle washer—depend upon continuous electrical power from a reliable, efficient distribution system. In scope and detail, this installation is a fine example of modern hospital electrification.

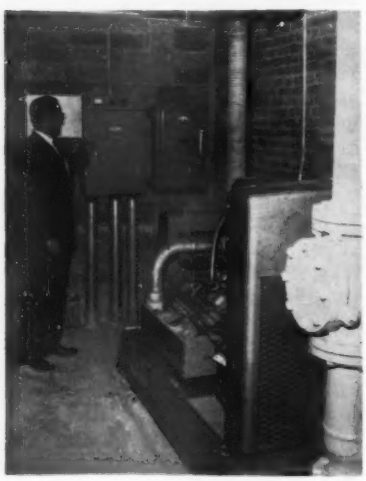
The new hospital building is a single-level structure, laid out as shown in the accompanying plot plan. The new building is actually an expansion of an existing hospital housed in a small building, to



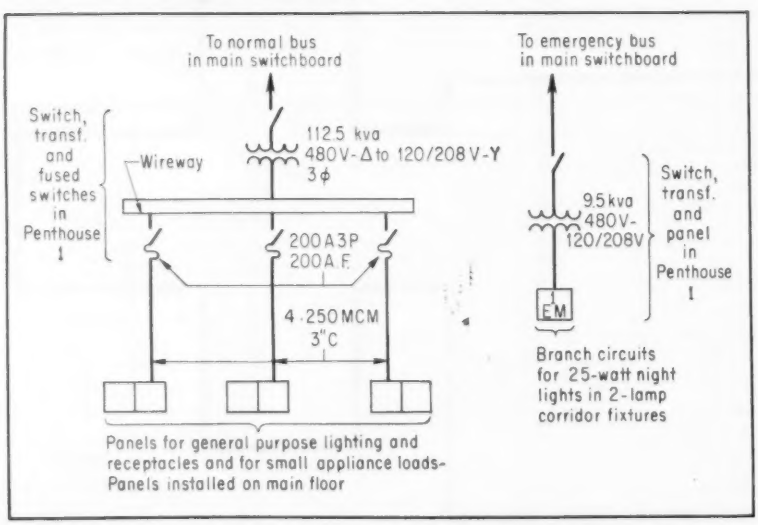
GENERAL LAYOUT of hospital shows various work areas and the correlation of the service, main switchboard and two roof penthouses, which are fed from main board and which are distribution centers for the building.



SERVICE CONNECTION to hospital premises is made from a wye-delta connection of utility transformers, with the 3-phase, 3-wire, 460-volt drop to a pole-supported bussed weatherhead and CT-cabinet assembly. Service conduits come out of the splice box and down the service pole into ducts run underground into the main switchboard in the mechanical room.



EMERGENCY POWER is a vital element in hospital electrification and is served here from a 75-kw, 93.75-kva generator (right) at 460-volt, 3-phase, 3-wire, 80% PF. The generator is driven by a 1000 Btu natural gas engine directly connected. A companion control panel and transfer switch (wall at rear) provides for automatic starting of the generator upon failure of normal power to the main switchboard, with transfer of essential switchboard loads to the generator. A 200-amp switch, fused at 150 amps, is mounted to the right of the transfer control unit and provides protection and disconnect for the emergency bus section in the main switchboard.

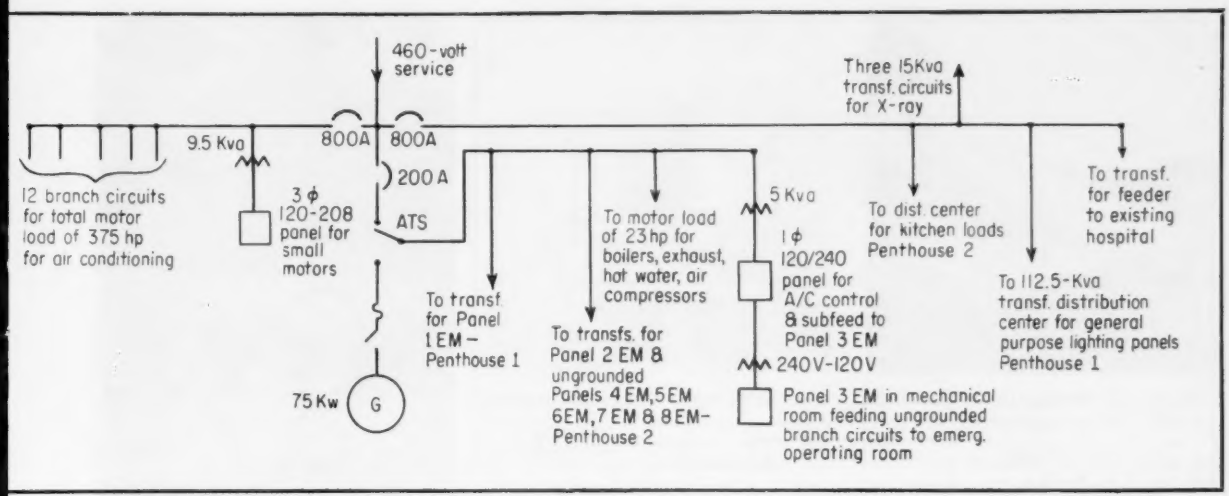


PENTHOUSE NO. 1 contains distribution equipment for general-purpose circuits and a panel for branch circuits to the night lighting lamps in corridor fixtures.

which the new building is joined. Based on discussion with the utility, a decision was made to remove the existing service entrance from the old building and supply both the new building and the existing building from a single new service entrance to the main switchboard in the new building.

Power for the entire installation is brought into a mechanical room in one corner of the building at 460 volts, 3-phase, 3-wire delta from utility transformers mounted on an H-frame at the edge of the property. The service feed is made to an enclosed, back-to-back, two-sided circuit-breaker switchboard. This board provides disconnect and overcurrent protection for feeders to various step-down transformers in the mechanical room and in two penthouses on top of the new hospital structure, feeders to distribution centers in the penthouses and a large number of branch circuits to motor loads—including two 125-hp airconditioning compressors, one 60-hp air handling unit and other motors ranging from large fractional hp to 15 hp. Most of these motor loads are in the first floor mechanical room. A few small integral hp motors for refrigeration compressors serving the hospital kitchen are in one of the penthouses.

Careful attention was given by Bernard Johnson & Associates to the provision of an emergency



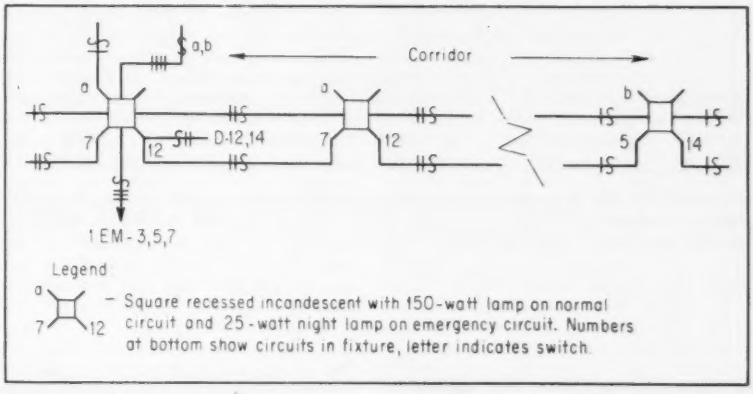
MAIN SWITCHBOARD is a totally enclosed, free-standing assembly of stationary structures bolted together and housing: combination CB-type reduced-voltage and across-the-line starters; molded-case air circuit breakers for protection of circuits; transformers for 120-volt control and small motor circuits; two panels for the 120-volt circuits and pilot lights and control switches for the starters. Specs required that all motor starters be equipped with running overload protection in all phases of the circuit. Circuiting of the board is shown in the single-line diagram above.

power supply for use if the utility service should fail. An emergency electrical generator is installed in the mechanical room adjacent to the main switchboard. The 460-volt, 3-phase, 3-wire output is fed to an automatic transfer switch which includes controls for automatically transferring a section of the main switchboard from the normal utility supply to the generator supply if normal supply fails. The division of loads between the sections of the main switchboard is shown in an accompanying diagram. Note that all essential loads are supplied from the bus section which can be transferred to the emergency generator. The air conditioning load, X-ray load and kitchen power and light loads make up almost all of the load on the non-essential bus sections.

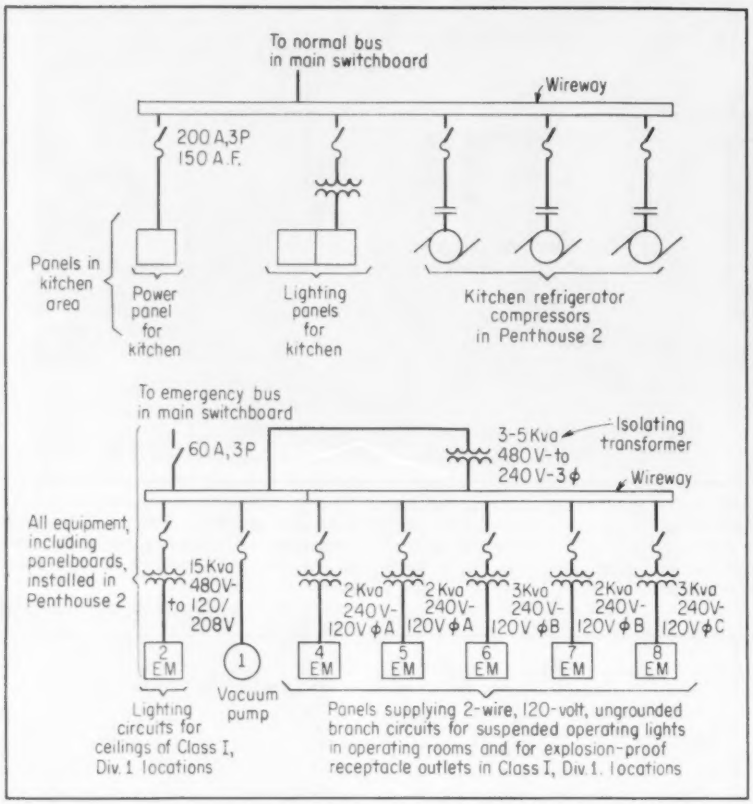
Distribution of power is made primarily at 460 volts, 3-phase, 3-wire. From the 460-volt system, step-down is made to 120/208 volts through 3-phase transformers to supply kitchen lighting and appliance panels and panels for general area lighting and receptacles. However, for circuits supplying areas used for anesthetizing—operating rooms, delivery rooms, anesthesia rooms and corridors and utility rooms used for administering flammable anesthetics — special provisions had to be made.

The National Electrical Code generally requires that circuits in the aforementioned rooms and areas must be supplied from an ungrounded distribution system which is isolated from any distribution system supplying areas other than anesthetizing locations. (NEC Sec. 517-6a). Such isolation is generally provided by means of two-winding transformers with no electrical connection between primary and secondary (that is, primary to secondary energy transfer must be made only by magnetic induction). It would seem, just from this, that the circuits could be provided by simply installing single-phase transformers for 480 to 120/240 volts or 3-phase transformers for 480-volt delta to 120/208-volt wye. But there is a further complication.

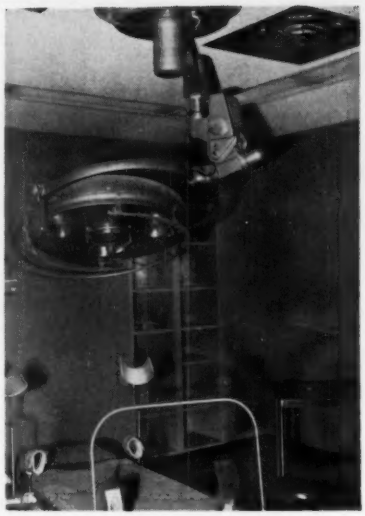
Section 517-6b of the NEC states that: "Circuits supplying primaries of isolating transformers (as required by 517-6a) shall operate at not more than 300 volts between conductors. . . ." This rules out the use of any transformer with a 480-volt primary for stepping down to the ungrounded distribution system for anesthetizing areas. As a



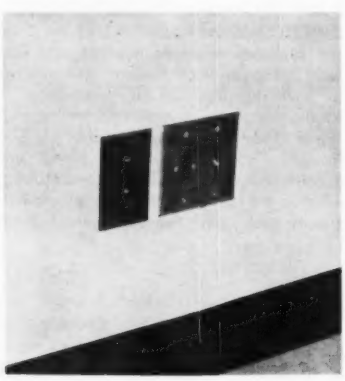
CIRCUITING ARRANGEMENT for 2-lamp corridor lighting fixtures throughout hospital provides separate conduit and conductors for normal-circuit lighting with 150-watt lamp in each fixture and emergency-circuit lighting with 25-watt night lamp in each fixture. In this diagram, "D" circuits 12 and 14 supply the 150-watt lamps and may be switched off at night by means of the wall switch at upper left. Panel D is fed from the normal (or non-essential) section of bus in the main switchboard. The 25-watt night lamps are fed from panel 1EM (circuits 3, 5 and 7 shown here) and operate day and night, with no local switching available. Panel 1EM is fed from the section of main switchboard bus which is fed from the normal supply and from the emergency generator when normal supply fails.



PENTHOUSE NO. 2 contains the non-essential distribution center for the all-electric kitchen and the essential distribution center for lighting and receptacle outlets in hazardous areas of the hospital.



SURGICAL FIXTURE in each delivery room and operating room is a 120-volt, 7-amp load-connected on an ungrounded 2-wire circuit and operated by a 2-pole wall switch. This conforms to Section 517-6 of the NEC, in which ungrounded circuits are required "within an anesthetizing location" (except that fixed lighting fixtures, other than ceiling-suspended or ceiling-mounted surgical fixtures, may be supplied from a grounded system—see Sec. 517-6e). The recessed fluorescent units, shown here, form a square in the ceiling and are supplied from a grounded circuit. The surgical fixture here is approved for this use and conforms to code requirements for Class I, Div. 2 lighting fixtures.

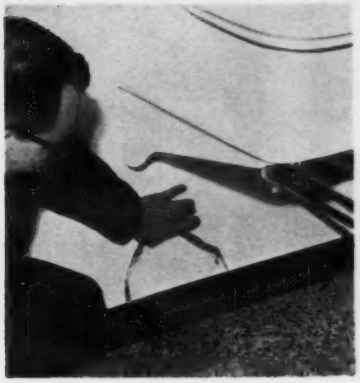


BEDROOM FEATURES include: (left) electric-motor-powered raising and lowering of the head and foot of each bed by means of a 4-button hand control on a cord, operated by the patient in the bed; and (right) television-set connection point in each room consisting of a duplex grounding-type convenience outlet for power cord connection of the set and a special outlet for signals and controls in the set. On the square plate, a screw-on terminal provides for connection of the set antenna and a rectangular, multi-pole socket provides for connection of a control cord from the TV set. This receptacle outlet is wired under the floor to the patient's bedside panel at which a hand control device is readily connected by cord to the panel, permitting the patient to control the TV (volume, channel selection, ON-OFF). Connection is also provided at the bedside panel for connection of a pillow speaker. A complete TV antenna system for four channels is installed in conduit to the bedrooms, fed from four roof-mounted antennas and signal amplifiers.

result, a two-stage transformation is necessary to obtain the ungrounded system from the 460-volt delta system. This transformation is made in one of the roof penthouses where a 460-volt 3-wire feeder from the main switchboard comes into a hookup of three 5-kva, single-phase transformers connected for 480-volt delta down to 240-volt delta. The secondary conductors are brought into a trough from which single-phase, 2-wire subfeeds are tapped to single-phase transformers (2 and 3 kva sizes) connected for 240 volts down to 120 volts. These small transformers provide required isolation of their secondary, 2-wire, ungrounded subfeeds to panels for the ungrounded branch circuits. The small single-phase transformers are divided among the three phases of the 240-volt delta secondary of the 3-phase transformer bank: two 2-kva units to phase A; a 2-kva and a 3-kva unit to phase B; and a 3-kva unit to

CLASS I, DIV. 1 equipment in each operating room, delivery room and anesthesia room includes explosion-proof foot-operated nurse-call switch (left) and explosion-proof, 120-volt receptacle outlet. In an anesthetizing location, "the entire area shall be considered to be a Class I, Div. 1 location which shall extend upward to a level 5 ft above the floor," per Sec. 517-2b. Storage rooms for flammable anesthetics are Class I, Div. 1 locations throughout.

GROUND CONTACT INDICATOR panel is mounted on the wall in each anesthetizing location. The ground alarm system is required by code Sec. 517-6d, which says—"the ungrounded system shall be provided with an approved ground contact indicator so arranged that a green signal lamp conspicuously visible to persons in the anesthetizing location remains lighted while the system is isolated from ground. An adjacent red signal lamp and an audible warning signal shall be energized when any conductor of the system becomes grounded—." This panel must be kept above the 5-ft boundary, out of the hazardous area. The panel is equipped with a test button which intentionally puts a ground on the ungrounded system for testing operation of the lights and buzzer. Such test is made when the area is free of gases or vapors. Each indicator panel is located in the location it serves. The detectors for the indicators are mounted adjacent to the isolating transformers and panels in the penthouse. The blank plates on the wall here cover locations at which seals are installed in the vertical conduit runs in the wall crossing the hazardous boundary at the 5-ft level. Conduit feeds come down from panels in the penthouse on the hospital roof.

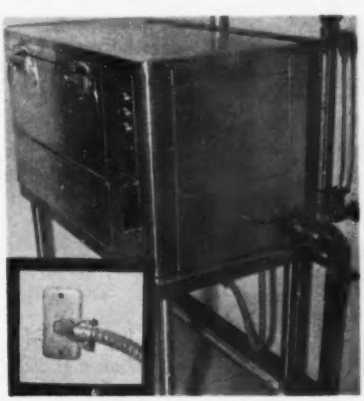


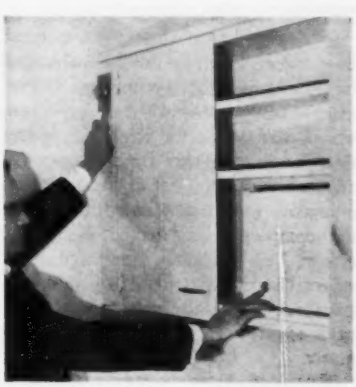
CONDUCTIVE FLOORING in anesthetizing location—labor room, delivery room, four operating rooms, fracture room and cystoscopic room—meets the requirements of Section 6-2 of the NBFU's Booklet No. 56 on hospital operating rooms. This states that the surface of the floor in anesthetizing locations, storage rooms for anesthetics, corridors immediately serving anesthetizing locations and rooms directly communicating with anesthetizing locations, must provide a path of moderate electrical conductivity between all persons and equipment making contact with the floor. Such a condition prevents accumulation of dangerous electrostatic charges which could ignite flammable gases. Conductive flooring quickly equalizes potential differences. Although grounding of flooring is optional in Booklet No. 56, the floor in the photo here is grounded by means of a grid of copper-foil strip laid under the carbon-vinyl conductive floor covering and brought out of the operating room for connection to a water pipe under the sink. To be effective as a conductive path, flooring must have a resistance of less than 1,000,000 ohms between two electrodes placed 3 ft apart at any points on the floor. But to protect against electric shock, resistance of floor must be more than 25,000 ohms measured as above, and between ground and any point on the floor.

phase C. This arrangement is shown in diagram at left.

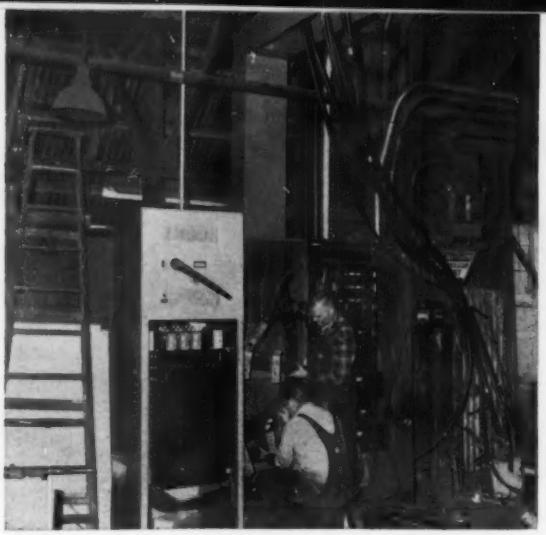
Hospital distribution systems commonly utilize 120/208-volt service to the building to avoid the need for two-stage transformations from higher voltage systems for ungrounded circuits. Such two-stage transformation necessitates higher investment in transformers than would be needed for one voltage transformation simply for isolation purposes from a 120/208-volt distribution system. In the hospital here, however, there was economic advantage in using the 460-volt distribution in spite of the equipment requirements for two-stage transformation. The use of the higher service voltage reduced costs of control equipment for the very large air conditioning and power load, and reduced copper and conduit requirements in the many feeders and subfeeders to distribution centers in the penthouses. Just the 400-hp total load of motors alone played a big part in these savings of a 460-volt system over 120/208-volt system. And the load of the completely electric kitchen made savings in feeder copper at 460 volts a significant factor.

Many of the details of distribution and modern hospital utilization are shown and explained in detail in accompanying photos. Architects of this hospital were Maurice J. Sullivan and Charles F. Sullivan.

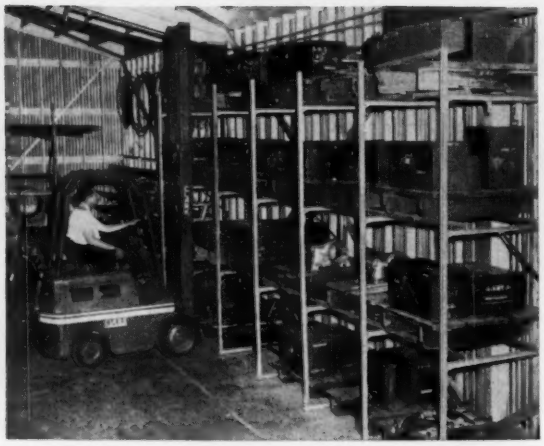




ELECTRICAL FEATURES abound in this hospital and include such items as: electric sterlizers (left) with permanent connection by bonded flexible conduit to wall outlet (inset); and (right) signal light in storeroom and another signal light at the nurse's station operated by door switch in the narcotics' safe to indicate when the safe is open, thereby providing alarm in the event of unauthorized entry.



MODERNIZATION of industrial service entrance relates plant requirements, as detected through tests and surveys, to knowledge of modern equipment and installation ability.



PALLET-MOUNTED toolboxes and major construction aids such as conduit cutters, threaders and benders are stored on warehouse racks by forklift truck after equipment has been checked and reconditioned upon return from previous projects.

Progressive Electric Service

A study of the methods, facilities and objectives of Pacific Electric Motor Co., a successful, large, diversified electric service organization.

IN 1907, a typical factory interior was a complex maze of flapping belts and shafting. And, although central steam power was beginning to give way to new fangled electric motor drives, this revolutionary concept had not yet secured a firm footing in industry.

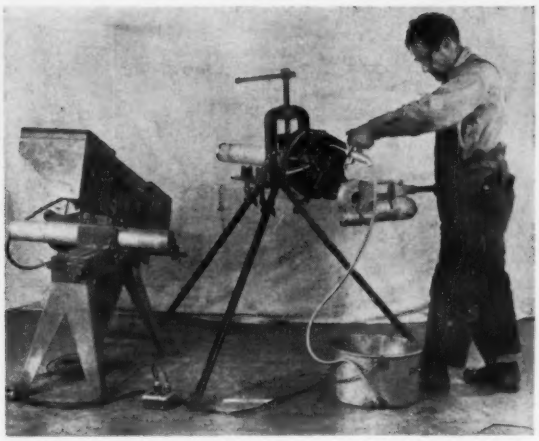
It was at this time that a small motor repair shop was established in Oakland, Calif.—a modest beginning for today's multi-interest multi-plant Pacific Electric Motor Co., which, after four moves to successively larger quarters, now operates an up-to-the-minute service complex with facilities, valued above $\$\frac{1}{2}$-million, designed for effective repair work, engineering, construction, fabrication and supply of electrical system components.

Each of these several fields is extensive in its own right. For example, repair work in Pacific shops relates both to motors and transformers, oil filtering and vacuum impregnation, metal spraying and machine work, dynamic balancing and applying epoxy resins to motors. Engineering includes design of electrical apparatus as well as complete distribution and lighting systems. Construction covers power and control, electric heating, explosion-proof installations, substation work, arc furnaces, electronic and control installations. Fabrication includes switchboards and control panels, transformers, special electronic and nuclear physics magnets.

Both Pacific shops contain modern equipment, while layout of departments is in logical relationship for sequence operation, and ample surplus space is available for future expansion. Work is segregated in shop areas, with separate departments devoted to large motors, fractional horsepower units, coil winding, machine work and operations related to different branches of construction. There is also segregation within stock areas, where separate storage is provided for new and reconditioned motors, fixtures and tools, replacement parts, wiring devices, conduits, plus a wide assortment of items related to electrical construction and fabrication.

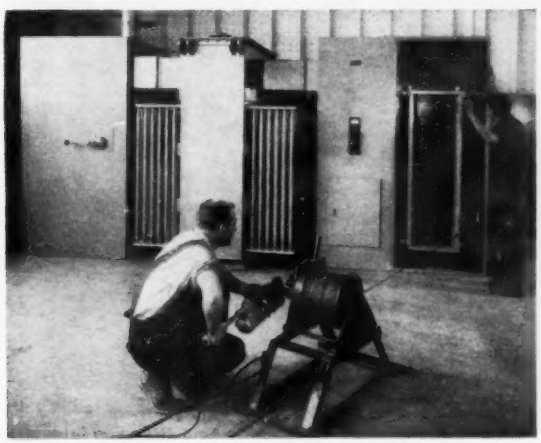
Indication of modern equipment is evident by mentioning such shop items as the several dynamic balancing machines, hydraulic presses, electric baking ovens and metal spraying facilities, and the many methods used for moving equipment, such as heavy-duty traveling cranes, forklifts and hydraulic tailgates on several delivery trucks, rolling dollies and specially designed pallets that permit efficient movement of construction materials and tools.

Engineering and office space likewise reflects efficient planning, for employees have the benefit of high-level diffuse illumination, while modern equipment ranges from



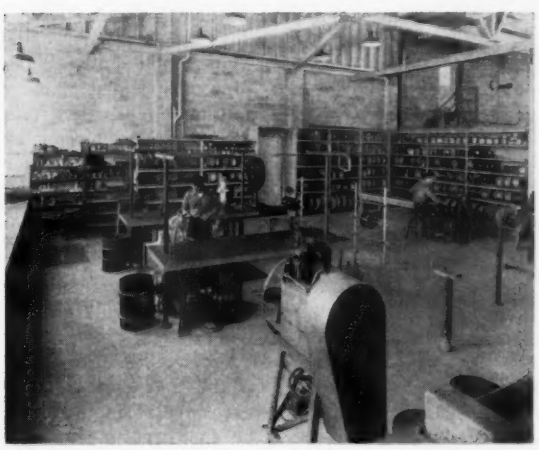
POWER-DRIVEN HACKSAWS, dies for cutting and threading large conduit, automatic pipe machines and wide assortment of power tools are maintained in constant condition, or are replaced by newer models in order to improve construction efficiencies.

DIVERSIFICATION of installation work ranges from primary transformer banks, as suggested by this view showing the wiping of lead joints on high-voltage potheads, to . . .

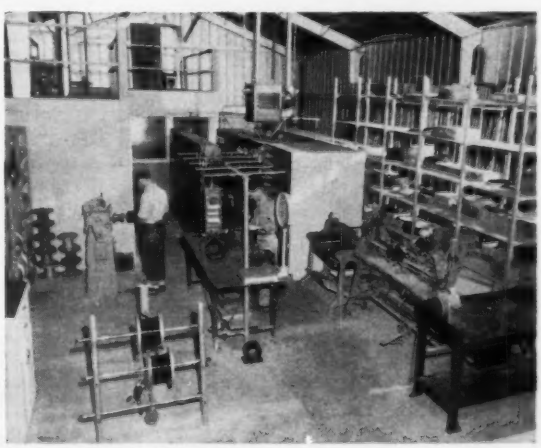


PULLING CABLE by motorized winch through conduit risers top-connected to 1000-kva unit substation, which was designed, fabricated and installed by this company, to . . .

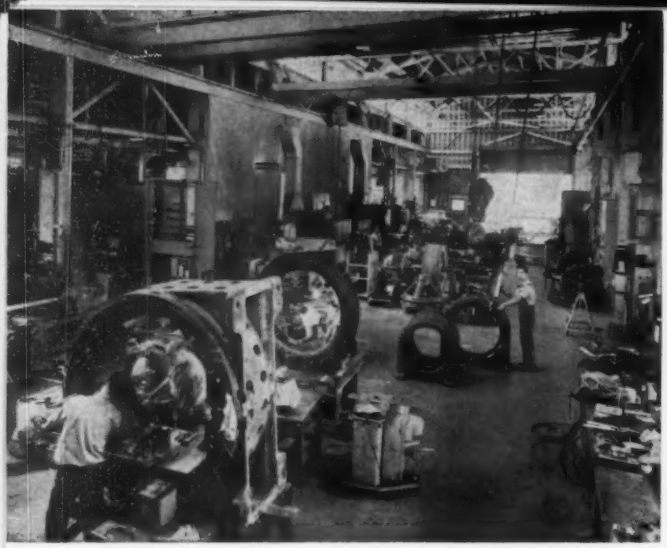
ILLUMINATION of industrial and commercial premises, determining requirements, planning layouts and control details, selecting equipment and installing complete projects.



COILS ARE WOUND in well-lighted, stocked and equipped departments having ample room for expansion, while adjacent areas have complete facilities for coil dipping and baking.



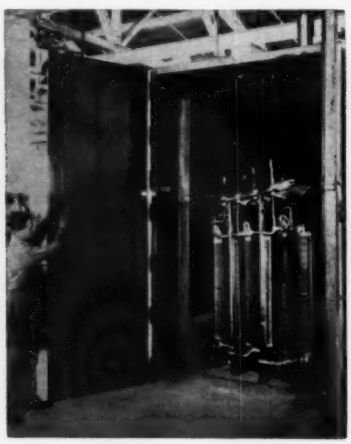
COIL DEPARTMENTS contain assortments of winding machines, forms and spreaders, slot insulation cutters and folding apparatus, weighing and taping facilities.



HIGH-BAY SECTION served by heavy-duty traveling cranes has generous space for shifting, dismantling and reassembling large equipment trucked in from customers' premises.

MOTOR REPAIR sections also include electrical test panels, hydraulic presses, lathes for machining shafts and turning commutators, metal-spraying equipment and the like, while . . .

AUTOMATIC 3-phase 500-kva step-type voltage regulator is assembled after rewinding of coils. Time and cost of such repairs are minimized due to proper facilities, tools, materials and experience.



LARGE BAKE OVEN easily accommodates transformer cores and heavy electrical equipment. Ample dimensions of oven and all other shop facilities, contribute to prompt completion of repairs.

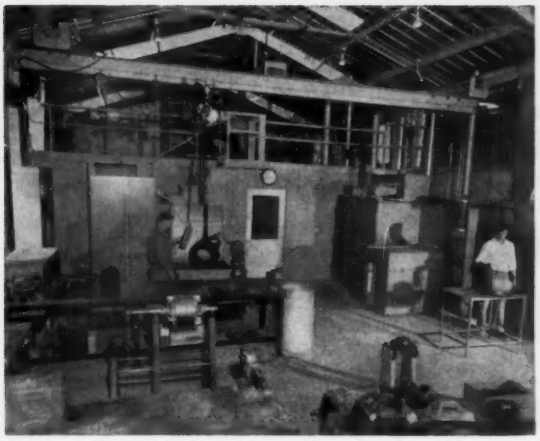
SWITCHGEAR design and fabrication demands basic understanding of fluid, pneumatic, temperature-activated and electrical controls, in addition to characteristics of breakers and fuses.

electric typewriters and comptabulators to blue-printing machines and intercom equipment.

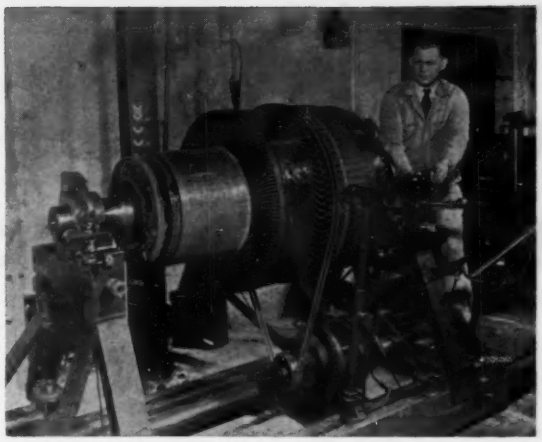
As emphasized by President Boyd, a business organization, to remain successful, must promote customer confidence by consistently rendering reliable, thorough service. This, in turn, involves such diverse things as knowledge of national and local codes, ordinances and safety regulations; understanding the purpose and operation of all electrical devices and materials; purchasing advantages obtained by combining financial resources with volume buying; guaranteed workmanship at reasonable charges to attract repetitive business; diversified knowledge and abilities resulting from experience plus continuous investigation of new products and methods; maintaining modern tools and testing apparatus in constant condition to insure accurate analysis and workmanship; comprehensive warehouse stock to minimize delays in fulfilling contracts; ample trucking facilities to transport materials and to perform outdoor underground or aerial work expeditiously; 'round-the-clock availability for emergency service; competent personnel in shops, offices and field assignments; plus practical engineering and installation know-how.

These intelligent objectives are frequently emphasized to employees as well as to customers, and customers are also advised that their best interests can be served by subscribing to available engineering services that go well beyond the scope of specified plans.

For example, clients are reminded that power costs can be affected by such things as power factor, demand, location of distribution centers, metering arrangements, voltage levels, service entrance facilities and the like. Signs of overloaded systems are likewise reviewed. Such signs as warm cables, switches or connections, and conditions leading to insulation failure are pointed out, such as excessive temperatures, moisture, or the presence of corrosive gasses or acids. In numerous instances, such comments have lead to plant surveys, and many

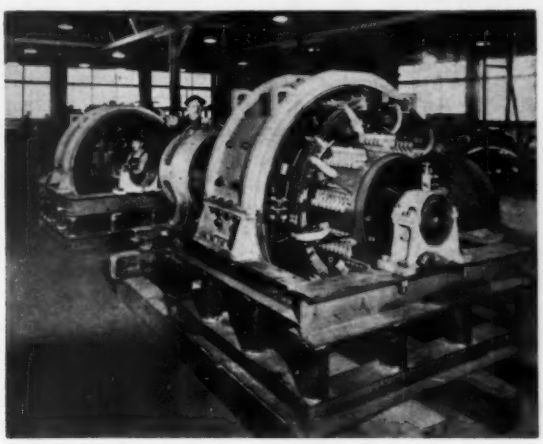


CHAIN HOISTS facilitate material handling. Note large distribution panel (left), electric bake oven and dip tanks (right rear) and exhaust hood over paint-spray area (right).



DYNAMIC BALANCING of rotating apparatus such as this large dc armature aids in determining position and extent of vibration-causing weight variation.

SPIRAL CORE laminations of 200-kva 2300-240/480-volt single-phase oil-immersed transformer are reinstalled and connected after winding.



MOTOR-GENERATOR set for dc shipboard service is reassembled after extensive testing, cleaning, reconditioning, baking and repainting.

surveys have suggested mutually beneficial programs for modernization.

These several objectives and practices constitute practical guideposts for the service industry as a whole, for it is the purpose of Pacific Electric to "furnish necessary and useful service through knowledge, constructive ideas and efficient methods; to merit confidence by making temperate statements and then fulfilling them to the letter; to treat customers fairly by relating reasonable profits to the values delivered, risks involved and knowledge required; and, by stimulating confidence and business by such practices, to promote our continued growth."

RELAYS AND SWITCHES on marine panelboards are wired and tested prior to installation in master complexes. Due to proximity of shops to Bay Area docks and shipyards, considerable navy and merchant-marine work is available to this organization.

In Industrial Plants . . .

Circuit and Equipment Identification Pays Off

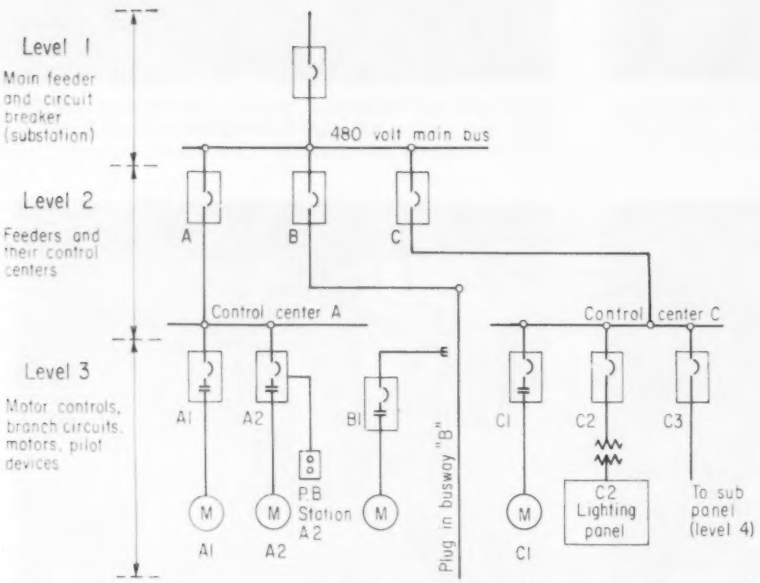


FIG. 1—One-line diagram of an electrical distribution system for a small industrial plant shows method of marking equipment from feeders to branch circuits.

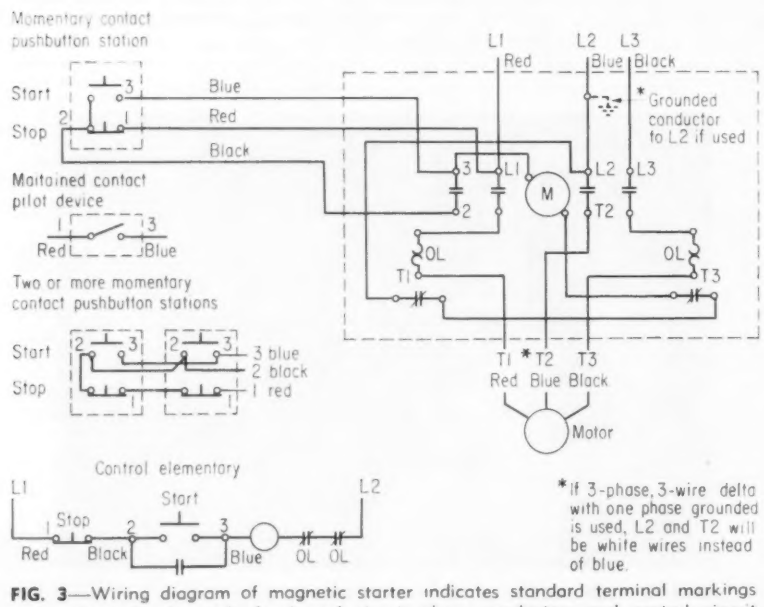


FIG. 3—Wiring diagram of magnetic starter indicates standard terminal markings and suggested color code for branch-circuit phase conductors and control circuit conductors. Note that L2 should be connected to the grounded phase if the supply is 3-phase delta with one phase grounded.

COLORS, letters and numbers put together in the form of a code can produce an optimum electrical installation in an industrial plant loaded with motor circuits and control wiring. From a contractor's point of view, adopting such a code speeds up the initial installation—by virtually eliminating wrong hookups and time consumed in "ringing out" circuits. The following account describes a code for identifying circuits and equipment, which our firm has found to be highly successful.

Electrical Equipment Designation

Providing a simple and logical system of designating electrical equipment in an industrial plant offers many advantages to the customer. For example, the power source, feeders, disconnects, fuses, CBs, motors, and control equipment can be located easier and maintained better if labeled properly. By doing this, new maintenance personnel or outside specialists can become familiar with the general layout of a plant electrical system much faster.

Our numbering system is easy to understand and pinpoints equipment to a specific location or level. Fig. 1 shows an example of a plant with a single main switch and several feeders. The term "level" indicates the electrical sequence from the service entrance. In this example, the main disconnect and bus represent level 1. Feeders and their fused disconnects or CBs are level 2. And motors and controls are level 3.

Designation starts with the feeders by giving each a different letter of the alphabet. Branch circuits are marked with the letter of the feeder plus the circuit number. Every component of a motor branch circuit (disconnect switch, CB, pushbutton station, motor,

A well-designed plant electrical system includes color coding of power-and control-circuit conductors, a logical system of marking equipment, and ASA designated methods for identifying the terminal connections of motors and transformers.

By Otto W. Walther,
Walther Electric Co., Hughson, Calif.

etc.) has the same designation. With this system, related equipment can be quickly identified; and in the event of equipment failure, this cuts time in locating and correcting the source of trouble.

Color Code

Establishing a conductor color code for branch circuits and control wiring reduces installation time and simplifies the correction of wrong hookups or faults.

Color coding of branch-circuit conductors is specified in Section 210-5 of the NEC. But it is generally conceded that this applies only to multi-wire branch circuits containing a grounded neutral conductor. In substance, this code section requires the following color code: 3-wire circuits—one black, one white, one red; and 4-wire circuits—one black, one white, one red, one blue. Section 210-5 further states that all circuit conductors of the same color shall be connected to the same ungrounded feeder conductor throughout the installation.

While this color system would not be required for 3-phase 3-wire motor branch circuits, we have found that using black, red and blue conductors for each 3-phase motor branch circuit is most practical. With this procedure, the phase rotation is apparent at each point of the system (junction box, disconnect switch, starter, receptacle, and motor). Often 3-phase receptacles will be installed in several parts of a plant for the connection of a portable 3-phase motor-operated machine (such as a welder) that will be moved to different locations as required. By following the color coding previously suggested, and connecting receptacle terminals as shown in Fig. 9, the proper phase rotation is assured at each receptacle. Thus, the motor terminal connections on the portable equipment need only be connected once for correct phase rotation.

Even for permanently connected 3-phase motors, color coding of phase conductors offers advantages. In addition to providing a uniform phase rotation throughout the system, troubleshooting faults is much easier. For example, assume a 440-volt, 3-phase ungrounded system in which the phase conductors are identified: L1-red; L2-blue; and L3-black. Should an accidental ground appear in L2, then attention need only be directed to blue conductors throughout the branch circuits in attempting to locate the ground.

Should a 3-wire 3-phase system be delta-connected with one phase grounded, the color coding suggested is red, white and black. The white color identifies the grounded conductor throughout the system while the red and black conductors identify the two ungrounded phases. With this system, no overcurrent device should be placed in the grounded conductor (except a CB which trips all poles simultaneously or as required by NEC Section 430-36).

If a 4-wire, 3-phase delta system is used, the color code we recommend is red, blue, black and white. The white wire identifies the grounded neutral, and the "high leg" is the blue conductor. There is a definite reason for selecting the blue leg for the phase conductor having a voltage 1.73 times the line-to-neutral voltage of the other two phases. A 4-wire delta system provides 3-wire 3-phase branch circuits (the three ungrounded conductors) and 3-wire single-phase branch circuits (the grounded neutral and the two ungrounded phases having equal line-to-neutral voltages). There are no 4-wire delta branch circuits.

Due to the provisions of NEC

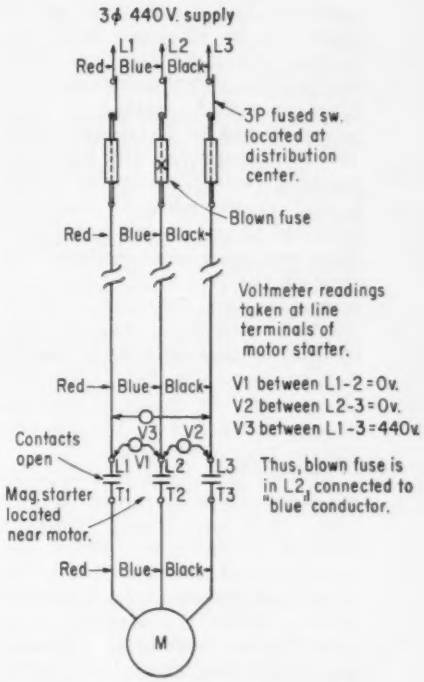


FIG. 2—Voltmeter readings pinpoint blown fuse, even when the test is made at line terminals of motor starter, if color coding is followed throughout system. Test shown in diagram, indicates that fuse connected to "blue" conductor is open. With the color-coded system, a second voltmeter test at the branch-circuit fused switch is not necessary.

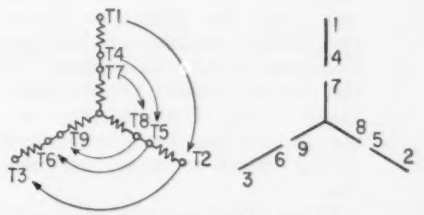


FIG. 4—Numbering of leads for a dual-voltage, Y-connected 3-phase motor is simplified by the use of an inverted Y. Terminals are numbered in sequence starting with T1 and progressing in a clockwise direction spirally to T9.

Section 210-5, the 3-wire, single-phase branch-circuit conductors must be identified (for at least one such circuit) as: one black, one white (neutral) and one red. As a result, the red and black conductors must be reserved for the phases that provide equal line-to-neutral voltages. This leaves only the "blue" conductor to identify the "high leg." At the same time, the choice of the blue conductor for the "high leg" does not violate Paragraph 200-6 (c) of the NEC. In this code rule, the high-voltage conductor of a 4-wire delta system need only be identified when the neutral is present (services, feeders, gutters, 4PSN switches, etc.). Since no specific method or color is established in Paragraph 200-6 (c) for identifying the high leg, the blue conductor seems to be the logical choice where a complete color-coding system will be adopted. This may raise some eyebrows in view of the fact that some power companies and state and local inspection authorities require that the high-voltage delta leg be identified by the color "red." On the other hand, the choice of red can be questioned due to the circumstances previously described.

Another advantage to color coding 3-wire, 3-phase power circuits (red, blue and black) concerns locating blown fuses. Often the branch-circuit fused switch is located some distance from a 3-phase motor. When the electrician is called to an inoperative machine, one of the first checks will be at the motor starter, usually located at the machine. With the starter in the OFF position, the electrician first tests the line terminals of the starter to detect a possible open fuse. In Fig. 2, successive phase-to-phase voltmeter readings have indicated that the blown fuse is in L2 (the blue conductor). Voltmeter readings between L1-2 and L2-3 read zero, while L1-3 reads 440. Now the electrician knows that he need replace only the fuse connected to the blue conductor in the remotely located branch-circuit fused switch. Without color coding, another test would be required at the switch to detect the open fuse.

If the aforementioned color coding is to be adopted, one item should be clarified—make all final connections for proper rotation of a 3-phase motor at the motor terminal box. By doing this, color coding will be in the same sequence for the respective poles of equipment throughout the system.

Color coding of control circuits also provides a system that is easy to install and maintain. Fig. 3 shows a typical control diagram with connections and suggested color coding. In addition to color coding, we use No. 14 wire for control conductors exclusively, with No. 12 wire and larger for motor-branch-circuit conductors.

In the event of a 3-wire delta supply with one phase grounded (shown in Fig. 3), terminal L2 should be connected to the grounded conductor. Also L2 and T2 would then be connected to a white conductor instead of blue one. The reason L2 should be connected to the grounded phase is that the overload protective relays in present-day motor starters are in T1 and T3; also, if a fault to ground occurs in a control wire that leaves the starter, the motor cannot start unexpectedly, since both sides of the holding coil would then be at ground potential.

ASA Standard C6.1 suggests uniform terminal markings on electrical equipment. Understanding the more common markings will shorten installation time, reduce errors and minimize damage to equipment. Fig. 3 shows the standard terminal designations for present-day magnetic starters. However, since standardization is

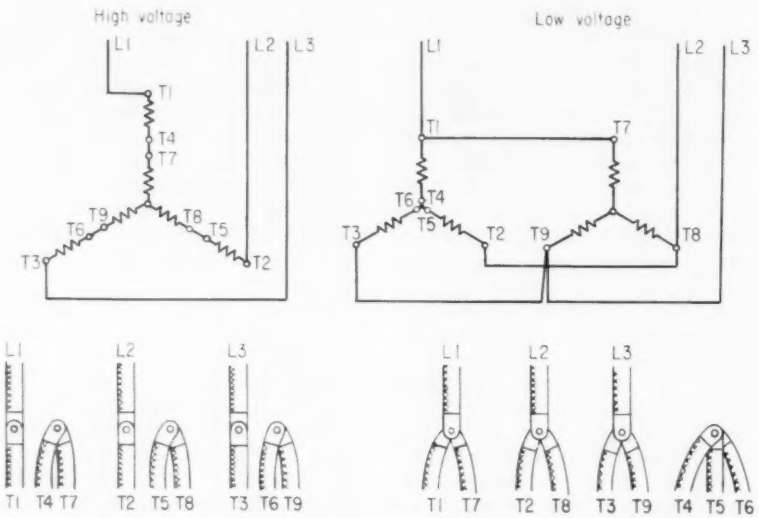


FIG. 5—Standard connections for dual-voltage Y-connected motor windings are shown in diagram. These connection designations comply with ASA Standard C6.1.

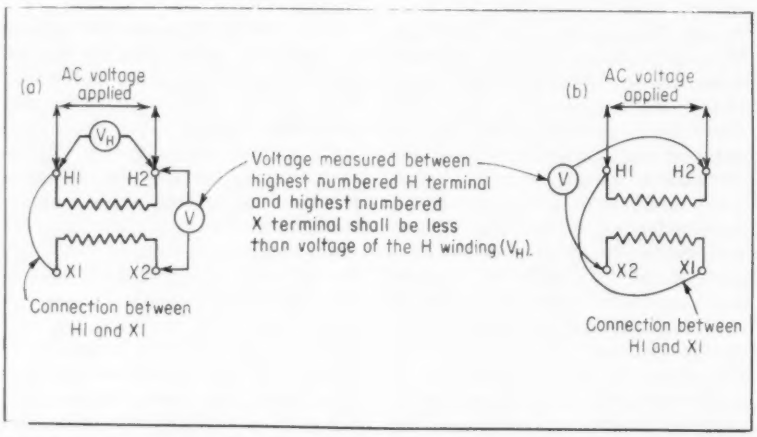


FIG. 7—A recommended test is shown to determine polarity of single-phase transformers. Polarity is subtractive (a) if H^1 and X^1 are adjacent. Polarity is additive if H^1 and X^1 are located diagonally across from each other.

fairly new, it is important to note, that in the past, terminal designations varied widely among different manufacturers.

An important consideration for the plant electrical department concerns original equipment labels, which are often lost or become illegible with age. For this reason, pertinent information on all electrical equipment should be kept in a separate file, or equipment diagrams should be supplemented to contain necessary information.

Also suggested in ASA Standard C6.1 are terminal markings for motors and transformers.

As shown in Fig. 4, the logical numbering of 3-phase motor terminals is derived from a schematic vector diagram, illustrating an inverted Y-connection with the circuit in each phase arranged for series connection. Starting with T1 at the outside of the diagram (Fig. 4), the ends of the circuits are numbered in a clockwise direction, proceeding on a spiral toward the center. For most Y-connected motors, the last three terminals are internally connected. As a result, only terminals one to nine are brought out.

Fig. 5 shows standard high- and low-voltage connections for Y-connected motor windings. And Fig. 6 gives the connections for delta-connected windings at high and low voltages.

In a delta-connected motor, the windings at points T1, T2, and T3 are internally connected with one external lead from each junction.

Transformers usually contain an attached diagram plate showing internal connections, markings, and possible voltages with various connections. High-voltage terminal markings are H^1, H^2, H^3, H^4, etc. For low-voltage terminals, markings are X^1, X^2, X^3, X^4, etc. In both cases the subscript numbers indicate a progressive potential rise.

As indicated in Fig. 7, the transformer terminal markings can also be used to determine whether the secondary winding polarity is additive or subtractive. Determining polarity is extremely important when transformers are to be connected in parallel or when single units form a 3-phase bank.

Fig. 8 (a) shows a delta-delta connection for three single-phase transformers of subtractive polarity; while Fig. 8 (b) shows a delta-delta hookup of two single-phase transformers of additive polarity and one of subtractive polarity. In both instances, the direction of rotation is maintained, and the angular displacement, as indicated by the dotted line, is zero degrees.

Fig. 9 shows a suggested color coding for connection to corresponding poles of several typical receptacles used in industrial plants.

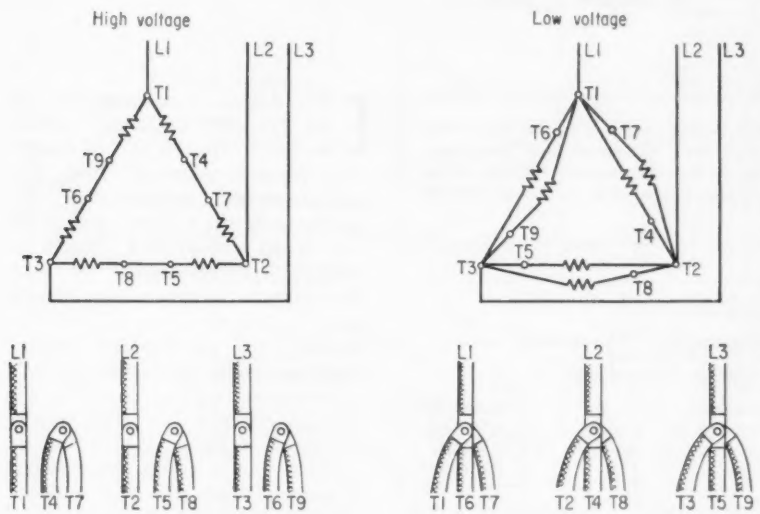


FIG. 6—ASA designation for dual-voltage 3-phase delta-connected motor windings are shown. Leads T1 to T9 are brought out in three groups (each group of three wires connected to two coils). The Y-connected windings in Fig. 5 have four coil groups (three separate coils each with two external leads and an internally connected 3-coil group with three external leads).

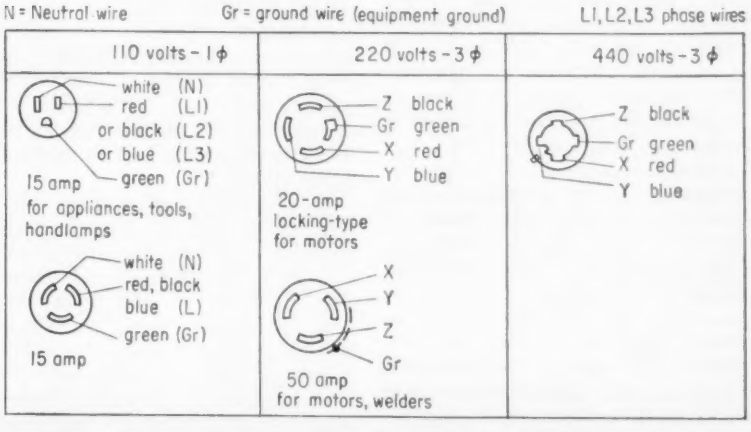


FIG. 9—A few common type receptacles found in industrial plants are illustrative. Suggested conductor color coding and corresponding terminal connections are shown. Such identification uniformly polarizes receptacles throughout a plant.

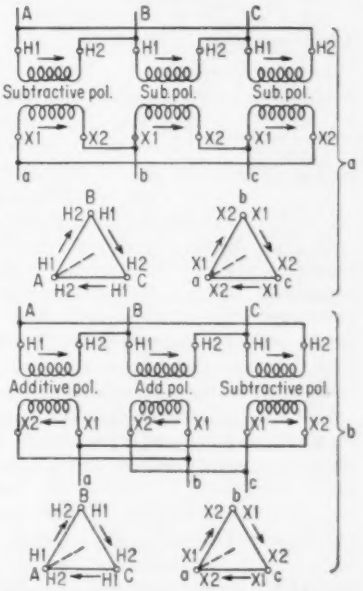


FIG. 8—In the diagram (a) shows a delta-delta connection for three single-phase transformers of subtractive polarity; while (b) shows a delta-delta hookup of two single-phase transformers of additive polarity and one of subtractive polarity.

Effective Maintenance Starts at the Top

A well-organized, carefully planned maintenance program is the key to successful electrical maintenance at Curtiss-Wright Corporation in Caldwell, N. J. Here, a primary-secondary selective power distribution system provides high service reliability plus flexibility of operation.

By Robert J. Lawrie

Fourth in a series of articles on current industrial electrical maintenance. Previous studies were: (1) Effective Large Plant Maintenance, April, 1961; (2) Effective Small Plant Maintenance, June, 1961; (3) Electrical Maintenance by Contract, August, 1961. This series covers operating procedures and work methods in typical industrial plants through personal interviews with key plant personnel.

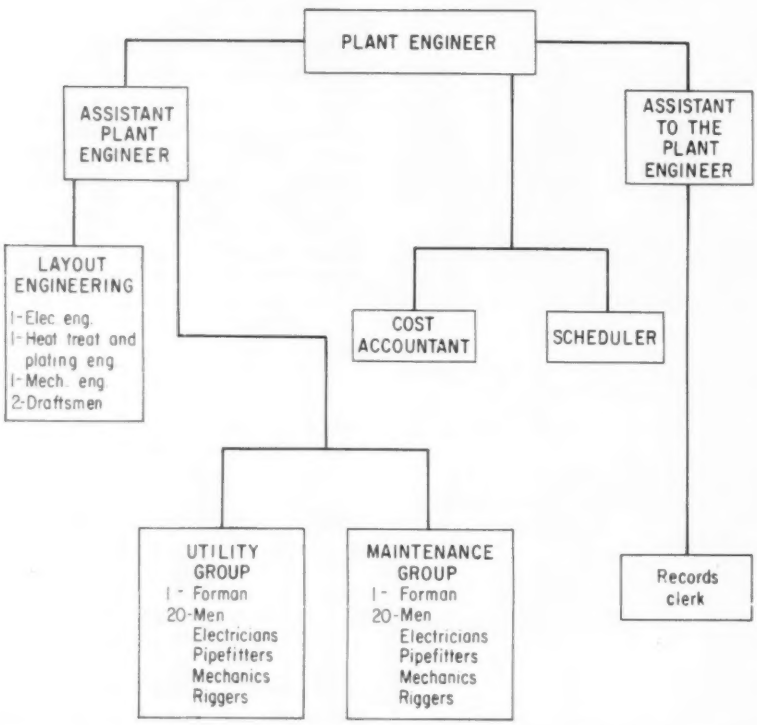


FIG. 1—The well-organized maintenance department has specialists to perform the various maintenance functions. Maintenance department personnel have clear-cut responsibilities, which result in high morale and efficient performance. Electricians, working under a central maintenance plan, perform electrical construction and maintenance.

ELECTRICAL maintenance at the Propeller Division, Curtiss-Wright Corp. is a part of a carefully planned program. Here, the well-organized maintenance department points up how specialized and direct supervision results in efficient performance. On the theory that its supervisors should have as few varieties of work as possible, the maintenance department has specialists to manage each maintenance function. And, for additional effectiveness, close supervision of work is applied where possible. As a result, maintenace is accomplished smoothly and effectively with management completely informed of all costs, equipment condition, and work load.

Efficiency of electrical maintenance is further increased because of the flexibility of the power distribution system. This system is a combination primary-secondary selective arrangement, which provides a high degree of service reliability and a means of performing maintenance on de-energized distribution apparatus without halting production.

This multi-building plant, constructed in 1940, produces various types of propellers and specialized aircraft parts. Main process equipment includes various types and sizes of metal-working machines, large heat-treat furnaces including resistance and high-frequency induction types, electroplating equipment, plastic-forming machines plus many types of control equipment. In addition to the vast manu-

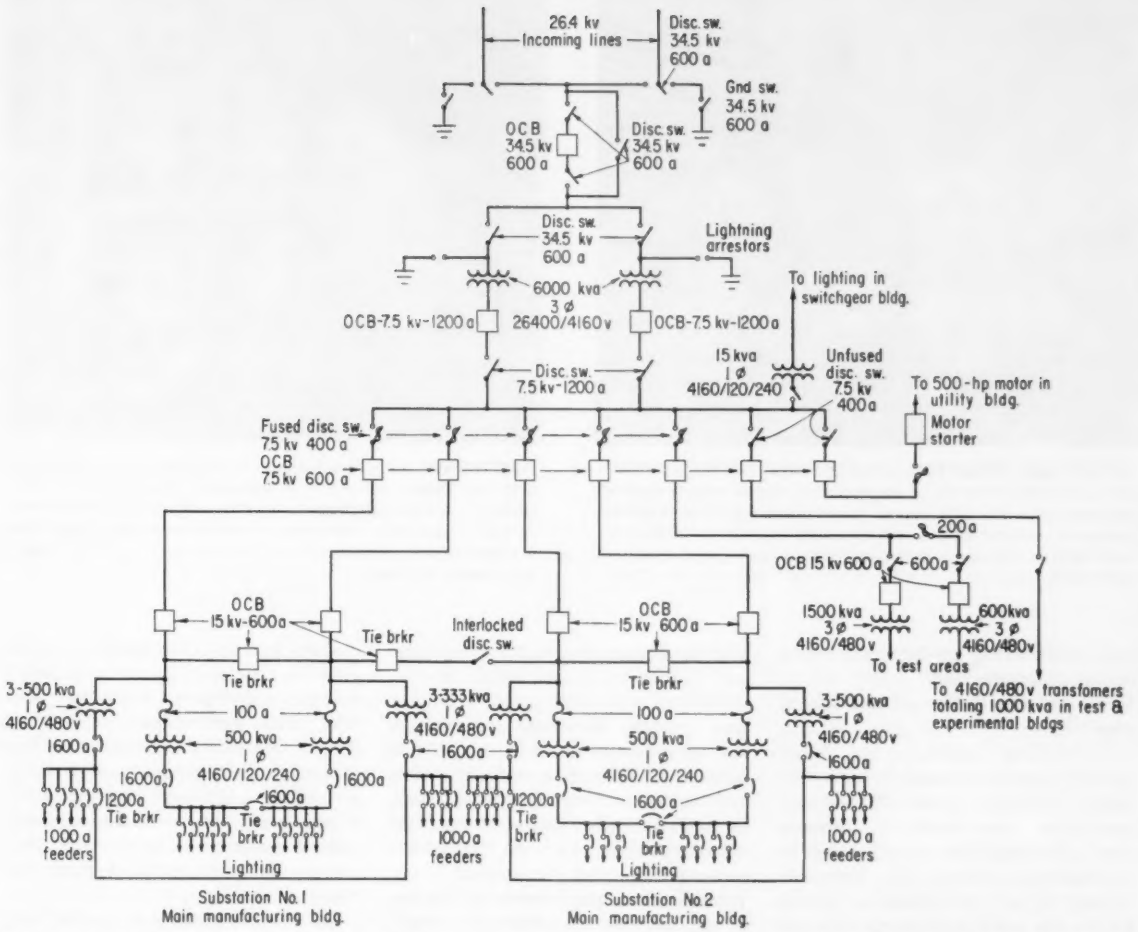


FIG. 2—Combination primary-secondary selective power distribution system provides a high degree of service reliability and a means to perform proper maintenance on de-energized distribution equipment without halting production. Each main feeder has the capacity to power its respective substation if a feeder fault occurs or a feeder must be de-energized.

facturing areas, the plant has extensive facilities for experimental engineering and testing.

A personal interview with John W. Campbell, plant engineer at Curtiss-Wright, is presented here describing his maintenance organization and his electrical maintenance program.

How is your maintenance department organized?

The department organization can best be seen in a block diagram (Fig. 1). As the head of the maintenance department, the plant engineer is responsible for costs, overall operations and planning. Under him, the assistant plant engineer supervises the layout engineering group, which consists of one electrical engineer, one heat treat and plating engineer, one mechanical engineer and two draftsmen. Also under the plant engineer is the assistant to the plant engineer, who handles special projects.

The maintenance department scheduler and cost accountant keep close control over the operation of the maintenance system. In addition, a maintenance clerk handles requisitions, job orders and preventive maintenance records.

Our central maintenance operation consists of two groups—the utility group and the maintenance group. Each group consisting of 20 men is headed by a general foreman. The utility group performs all new construction, equipment installation, major changes and similar work. The maintenance group performs all preventive maintenance and repairs. We also have a welder who works with both groups as required.

Are the men in the utility and maintenance groups all-around men or specialists?

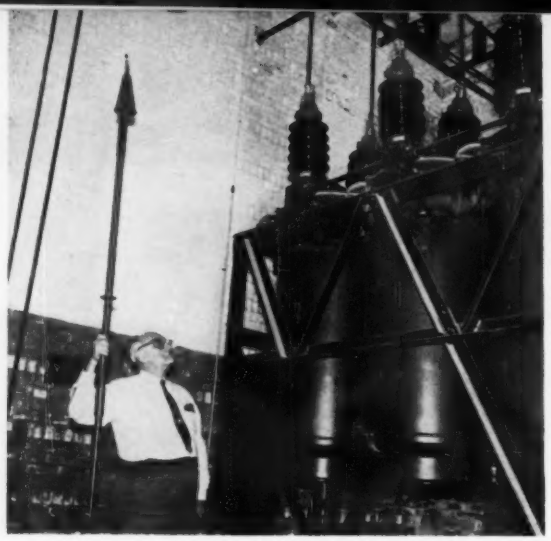
These men are hired to work as specialists in their own field. We have found that when each man has clear-cut responsibilities and knows just what is expected of him, he performs his work more efficiently, resulting in higher quality workmanship.

Both groups consist of electricians, mechanics, pipefitters, riggers and helpers. The utility group has three electricians who specialize in electrical construction. In the maintenance group, three first-class electricians and two second-class electricians perform electrical maintenance.

However, the general foremen have a practical working knowledge of all trades. These men were selected as foremen primarily because of their leadership and organizational abilities.

What is the function of the layout engineering group?

This group designs and organizes all new construction projects, equipment installations or major changes. They will also assist with



ELECTRICAL ENGINEER David S. Vogel, holding a "buzz stick," stands in front of the main oil circuit breaker, which is rated 34.5 kv, 600 amps. When the buzz stick is placed close to an energized high-voltage conductor, a neon, mounted in the stress cone, will glow and a buzzing sound will be heard.

ELECTRONIC recording controllers regulate temperatures in both the resistance and high-frequency type furnaces. Electricians perform scheduled electrical PM on this equipment. A meter specialist calibrates controllers, meters and other electronic controls monthly and troubleshoots electronic equipment when necessary.

any engineering problem that may occur in production.

What are the duties of the scheduler?

Scheduling maintenance work properly and accurately is a difficult, full-time job. To obtain maximum maintenance department efficiency, he must be able to accurately estimate the time required for all maintenance operations. He schedules work daily as well as keeping tabs on larger jobs.

We feel it is an advantage to the maintenance department to employ a scheduler because he performs the time-consuming job of scheduling work, allowing maintenance supervisors to have more time to provide closer supervision of work.

What are the duties of the cost accountant?

He keeps all maintenance department cost records. These records include costs of labor and material, plant operation, spare parts and new construction. Reviewed monthly by the plant engineer, these records provide a comparison of maintenance work output with costs.

What special projects does the assistant to the plant engineer handle?

His most important project at present is preventive maintenance. It is his responsibility to see that all PM is scheduled and performed properly. He is continually studying all utility, production and experimental equipment in order to find the proper inspection frequency and the best PM methods. In consultation with the plant engineer and general foremen, he designs the equipment-record forms, check lists and other paper-work media for maximum effectiveness. And, to arrive at the most efficient PM schedule, he works with the scheduler and the cost accountant.

What is the significance of having a specialized maintenance staff, and how does it improve electrical maintenance?

When a maintenance department has a specialized staff, maintenance supervisors will have more time for direct supervision. This close contact with the workers helps to eliminate that "out-of-sight out-of-mind" feeling as well as helping to get work done efficiently.

Moreover, maintenance supervisors have more time for planning and preparing work assignments, which can greatly increase efficiency.

And, because of a logical division of functions, the morale of all personnel is high. As a result, there is a significant increase in maintenance productivity.

Because electrical maintenance is an integral part of the over-all maintenance program, it shares in these benefits. Also, the electrical maintenance crew obtains additional benefits because of the flexibility of our distribution system.

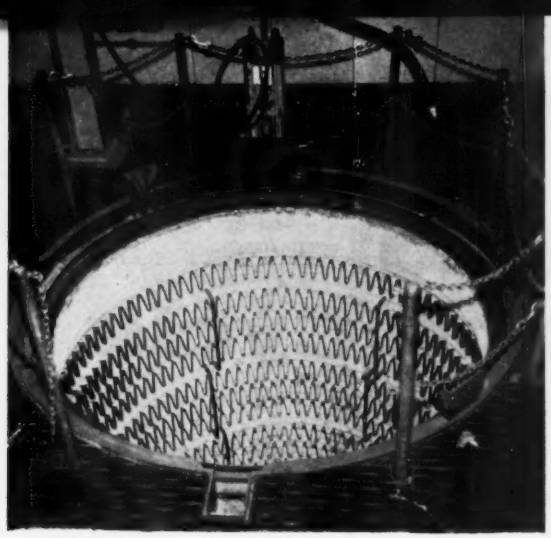
How does your power distribution system provide advantages in electrical maintenance?

Our power distribution system may be classified as a combination primary-secondary selective system. This arrangement offers optimum flexibility for operating and maintenance purposes as well as providing high service reliability. When compared to a radial load-center system, it is evident that our power distribution system has many advantages.

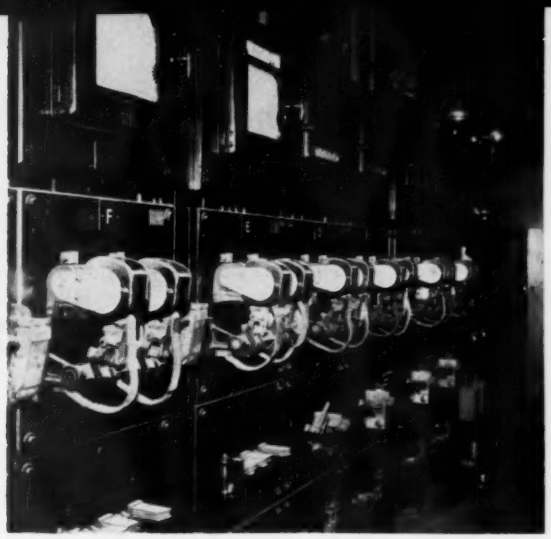
In most radial load-center systems, one primary feeder supplies each substation, and one secondary circuit supplies each feeder load. Although it is generally agreed that radial systems are quite reliable, a fault on either the primary or secondary lines could mean a lengthy shutdown. And proper maintenance of this kind of system is more difficult because in order to work on de-energized distribution apparatus, the production equipment that it supplies must be shut down.

Referring to our primary-secondary selective system, Fig. 2, note that in the important manufacturing areas, two primary feeders supply each substation and that primary tie breakers form a loop. This provides maximum reliability because any part of the system can be fed through various paths. In addition, tie breakers in the secondary arrangement permit the load to be supplied from either of two sources.

Besides providing high service reliability, this arrangement allows us to completely isolate transformers or circuit breakers for mainte-



ELECTRIC furnaces, used in a heat-treat process, have nickel-chrome base heating elements. Monthly, heating-element connections are checked for corrosion or overheating. Also, heating-element supports are checked. If these supports loosen, the elements may sag and contact an adjacent element which may eventually result in a burned-out element.



OPEN-MOUNTED CONTACTORS make and break the low-voltage high-current power supplied to the resistance type furnaces. Electricians inspect and clean the contacts once a month. Other maintenance procedures include checking contact pressure, changing contactor pressure springs when necessary and changing the flexible copper braid when worn.

nance without holding up production equipment.

How do you accomplish electrical preventive maintenance (EPM)?

The assistant to the plant engineer, after consultation with the scheduler and the general foremen, has the preventive maintenance program set up on a planned and scheduled basis. Electrical preventive maintenance is an integral part of this program.

All equipment is recorded according to type and frequency of inspection. These equipment records include inspection schedules and check lists. Also noted are equipment changes, moves, repairs and details of maintenance work.

The PM inspection schedule is integrated into the daily work schedule of the maintenance group. When machines are due for inspection, a notice is sent to the proper production supervisor a week in advance. He can then plan for these maintenance inspections or request a delay if it is necessary.

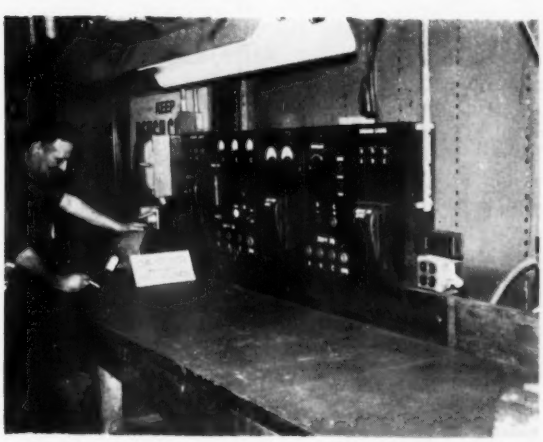
A typical PM team, made up of an electrician, a pipefitter and a mechanic, will inspect each machine or equipment as a group. Each man has his own check list and is required to inspect only those parts of the machine related to his trade. The assistant to the plant engineer receives the completed check lists for review and filing.

How do you maintain your electrical and electronic control equipment?

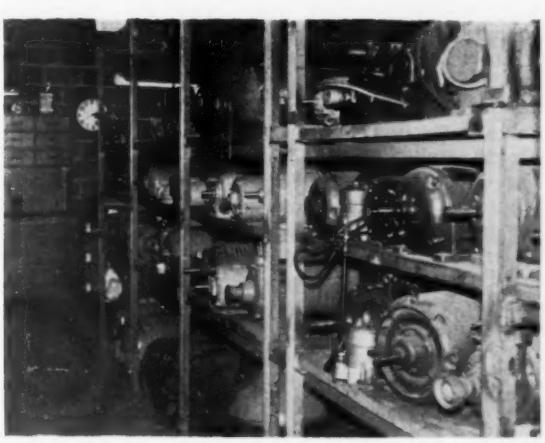
Maintenance electricians service electrical control equipment according to schedule. At the scheduled inspection, electricians clean and check relay contacts, and look for loose or overheated components.

Preventive maintenance of electronic equipment generally in-

(Continued on page 233)



MOTOR TEST BENCH, located in the electrical maintenance shop, facilitates troubleshooting, repair and testing of motors and other portable electrical equipment. Test panel provides 440 volts, 3-phase; 220 volts, 3-phase and 220 volts dc variable through a rheostat. Also mounted on the panel are appropriate ammeters, disconnect switches and receptacles.



SPARE MOTORS include gear motors, ac induction, and dc motors ranging in size up to 50 hp. When a production-area motor fails, electricians replace it with a spare motor. The defective motor is brought to the test bench, repaired, tested and placed on the spare motor shelves. If the windings are burned-out, the motor is sent to a repair shop.

For air conditioning large buildings . . .

The Heat Conservation Cycle

Here's the basic concept of a new and efficient method for electric-powered air conditioning—a method to be used in a large new Post Office building which will be built in Houston, Texas. This story typifies the electrical engineer's approach to the "total energy" consideration for economy in the integrated design of a modern building.

By Dale S. Cooper, *Consulting Engineer, Houston, Texas*

IN THE application of heating and air conditioning equipment to large buildings, the consulting engineer is continually confronted with many decisions pertaining to type, kind, location, methods, occupancy, purpose, and other considerations which will produce the most desirable conditions, at the lowest cost consistent with good engineering practice. More important still are the costs of maintenance, repair, and operation over the active life of the system, because these items materially affect amortization rate and profit, and should be very carefully considered in the initial design of the system.

While many engineering advances have taken place in the control and distribution of conditioned air throughout a building, there has been a reluctance to consider anything but conventional means for producing the chilled and hot water necessary to bring about desired results. Thus, when heat is needed, boilers are fired for hot water; and when cooling is needed, cooling machines are started; and "Never the twain shall meet."

So different is the production of heat versus the production of cold, that many systems are designed with a single circulating piping system for the dual operation. When systems of this type are reversed from heating to cooling, or vice versa, the losses are considerable, particularly when the reversal has to take place quickly. Hot water has to be cooled, and cold water has to be heated. Unfortunately, there is no fine line between the heating and cooling requirement, and no individual operator can tell precisely when to shift the system, nor can any amount of automatic temperature control be devised to accomplish this purpose satisfactorily.

The modern large building, with its varying types of occupancy—lobbies, cafeteries, offices with different exposures, enclosed first floor stores, beauty shops, interior spaces with no exposure, basements, and the like—represents an ever-changing load requirement on the air conditioning system, which can only be accomplished by simultaneous heating and cooling mediums. One does not have to have any engineering knowledge to realize that when varying outside weather conditions are superimposed upon the varying inside occupancy and lighting conditions, the air conditioning system must be designed to be flexible enough to meet each condition as it occurs, regardless of the variables involved.

In analyzing many of the more recent large building installations, we find that the mediums have been separated, two pipes for the hot water, and two pipes for the cold water, which permits the automatic controls to select either or both of the mediums at the air-handling units to maintain the desired conditions in each space. Of course, they fire a boiler to produce the hot water, and run a cooling machine to produce the chilled water. But, doesn't it seem rather foolish to be burning one kind of energy to put heat into a building, and at the same time, use another form of energy to pull that same heat out of the building? Especially, when they both cost money!

A system can be designed, using conventional equipment, which will take the heat extracted from the chilled water and produce large quantities of warm water for use in the building at the same time. Under these conditions the heat from areas, or zones, in the building requiring cooling can be distributed to other portions of the building requiring heat at the same time. This type of system is referred to, by the writer, as the "Heat Conservation Cycle." It is not what is called a "heat pump," because it is not reversible. A heat pump usually infers a reversible process, whereby heat is extracted from the outdoors, and is pumped into the building. The "Heat Conservation Cycle," therefore, merely spreads the heat around inside the building, concentrating it in areas needing heat, and using as its source of heat the areas needing

cooling. In carrying this thinking a little further, a centrifugal refrigerating machine is nothing but a uni-directional heat pump. It takes what we call "Blue" Btu's from the circulating chilled water, accumulated from the areas having too much heat and by compression makes "Red" Btu's from them, which are hot enough to produce usable heat at other locations in the building. Actually, we get 25% more "Red" Btu's from the discharge of the machine than the "Blue" Btu's entering the machine. This is due to the heat of compression, or work done, on the refrigerant by the driving motor. On conventional systems, all the "Red" Btu's are dissipated to the cooling tower, and new "Red" Btu's are produced by a boiler for heat. What a waste!

The heat conservation cycle, as the name implies, conserves all the usable heat needed by the building, and automatically dissipates only the balance, or excess heat to the cooling tower. Depending upon building type, usage, and location, boilers may be eliminated entirely as a source of heat in many cases. A study of outside weather conditions in the particular locality and the nature and extent of the cooling loads imposed upon the building will reveal the feasibility of such a system. Even in the so-called colder climates, where boilers may not be entirely eliminated, it will reduce considerably the size of the heat plant required, unless, of course, another source of "Blue" Btu's is found. Such other sources might be inexpensive well or city water, lake or river water, etc. These sources should be investigated on a purely economic basis. During extremely cold weather when "Blue" Btu's are hardest to obtain, and the demand for "Red" Btu's is greatest, some auxiliary source may be required to augment the cooling load on the machines. But even if boilers have to be used, their size and capacity may be reduced by as much as 75%.

There are many other factors which should be investigated, all of which have a direct bearing upon the successful application of the conservation cycle:

1. **The heat capacity of the building.** This is the ability of the building to resist temperature change, and is a function of its physical mass, in tons of steel and concrete. The mass acts as a tremendous flywheel and usually is very effective in ironing out rapid and extreme outside temperature changes, with the result that these changes are not even felt by the heating and air conditioning system. The building tends to follow the averages, rather than the extremes, of temperature variation, which is helpful to system design. Conventional systems usually consider only steady-state heat flow, in and out of the building, and as a result, plant capacity is usually oversized because of neglecting heat capacity.

2. **Fresh air requirements** introduced, for ventilation purposes, should be studied and controlled to obtain maximum benefit, without wasting cooling or heating capacity. This item, usually uncontrolled in conventional systems, represents one of the largest contributors to system inefficiency.

3. **Utilization of waste heat sources.** Waste heat sources show up in the most unexpected places. Each source should be investigated for type, size, and the economics of utilization. While each building is different, a few of the more common sources are listed below:

(a) Hot air exhaust ducts from kitchen stoves, dishwashers, coffee urns, etc.

(b) Basement machine rooms and engineers' offices.

(c) Transformer vaults. These losses are continuous, and power companies spend considerable money to ventilate same. This heat can be obtained with very little expense by passing the hot ventilation air over cooling coils, which are refrigerated only in the winter time.

(d) Commercial refrigeration compressor heat. These are usually in operation on a year round basis; and if of considerable size, dissipate large quantities of heat.

(e) City water is an excellent source of heat to handle short duration extremes. One million "Blue" Btu's can be purchased from the city for one dollar, assuming rates at about 20 cents per one thousand gallons.

But, someone might ask the question, "Why go after these Blue Btu's, when heat can be obtained from some other source, such as, gas or electricity"? The answer, of course, lies in the miracle of the vapor compression cycle. If a cooling machine can operate close to full load, by the application of these "Blue" Btu's from any source, it will pump from three to four times the heat equivalent of the input to the motor. In other words, if power is consumed in the driving motor at one cent per hwhr, about four times as many "Red" Btu's can be obtained as usable heat from the discharge of the machine. Thus, these "Red" Btu's are costing the equivalent of one-fourth of one cent, which is 2.5 mil power. This very closely approaches the cost of gas, without the disadvantages of boilers, auxiliaries, maintenance, control, and operation. The advantages of the heat conservation cycle, where applicable, are many, even when compared with its first cousin, the "Heat Pump Cycle."

1. No costly outside pickup-heat exchangers are necessary. This item alone, for large systems, places the heat pump at a distinct disadvantage, costwise.

2. No cumbersome and expensive transfer valves are required.

3. No reversal of system operation is necessary, with the attendant difficulties of knowing when to reverse.

4. Control is relatively simple, with automatic smooth flowing maintenance of desired conditions, regardless of what happens outside.

5. By continuous machine operation from summer to winter conditions, and all points in between, there is excellent opportunity for continuously correcting power factor by synchronous motors.

6. Here, at last, is a system, which, with simple automatic controls, allows the operator to walk away from it with no thought regarding its ability to maintain proper conditions in all zones, and under all outside conditions.

The cost of such a system is usually considerably less than any other system for producing year round conditions. The only additional items of cost over a conventional system, are:

1. Increased size of condenser shell and tubes to accommodate the two separate water circuits. (Hot water and cooling tower water.)

2. Extra water jacketing at each end of condensers to form the two water circuits.

3. Extra cost of utilizing waste heat, where feasible.

4. Additional control of outside air intake, and machine loading controls.

To offset these costs, the elimination of a complete boiler plant, with its stack, condensate pumps, steam, water and gas piping, control, and other auxiliaries, together with reduction of space for same, usually tilts the cost scales in favor of the heat conservation cycle, by a wide margin. From a maintenance and operation standpoint, the conservation cycle inherently has the advantage over most other systems.

Reference is made to the accompanying schematic diagram, showing how the heat conservation cycle operates. It may be explained as follows: (Diagram at right.)

Winter Operation:

A. Cooling coils in various zones, spaces, and waste heat sources, add heat to the chiller, ("Blue" Btu's).

B. The compressor removes this heat by evaporating refrigerant, and elevates its temperature level by producing high pressure in the condenser, ("Red" Btu's).

C. Circulating water in the building heating circuit picks up heat from the hot refrigerant gases, and uses it to heat zones requiring heat, or for reheat where positive control of humidity is required. Hot water and cold water is available at all times to satisfy any possible zone or space requirement, under all outdoor conditions.

D. The cooling tower circuit removes and dissipates any excess heat not needed in the building; to hold a scheduled condensing temperature on the machine. As the outside temperature drops below 60°F, the condensing temperature of the machine is rescheduled higher to make the circulating water hotter. This compensation with outside conditions is very desirable in any heating plant.

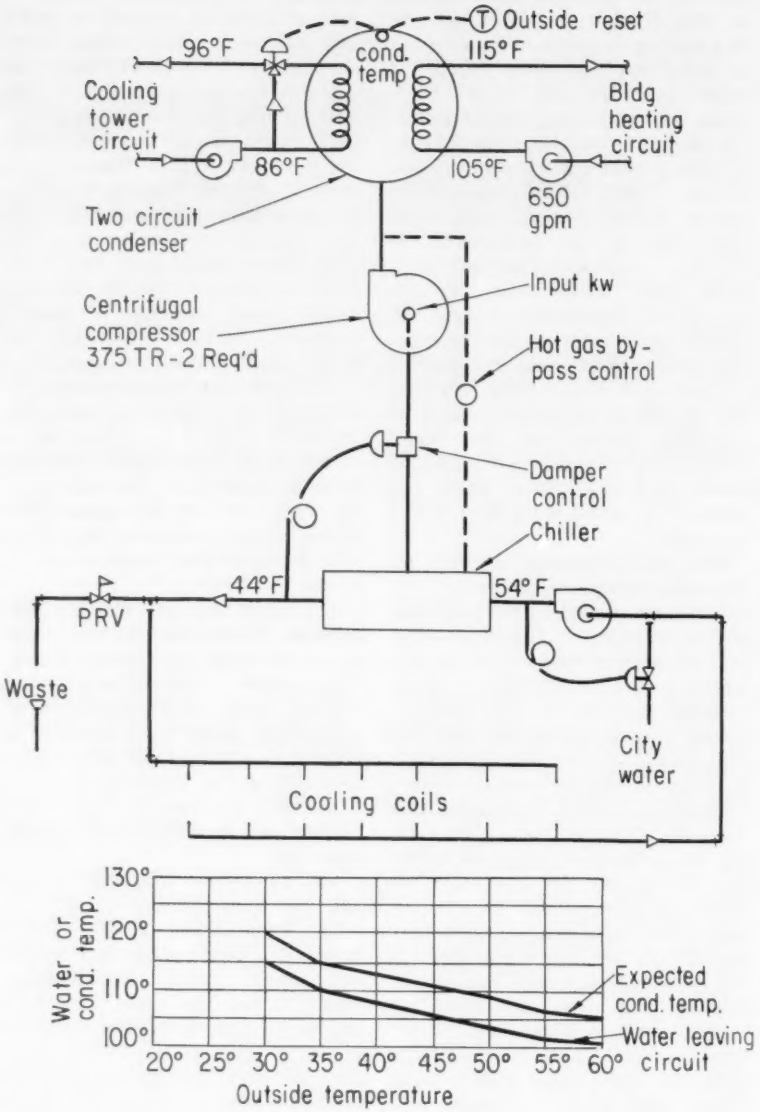
E. Control of machine surging, due to a reduction of load, is controlled by the hot-gas bypass.

F. Short period loss of "Blue" Btu's due to extremely low temperatures outside is provided by city water injected into the chiller to insure building heat under these conditions. Waste heat units should be "on" prior to water injection.

Summer Operation:

A. Same as for winter, with exception that building heating circuit may be shut off, if not needed.

B. Condensing temperatures are normal with cooling tower dissipating most of the heat in the usual manner.



Outside Air Control:

The introduction of outside air for ventilation is an extremely important function of any good air conditioning system. Proper quantities have been carefully worked out and published for various types of occupancies; but, practically, the proper quantity for a given building must be determined by experiment after normal operations have been established. From a practical standpoint, the ventilation requirements for heating are not nearly as great as they are for cooling. Thus, in the conservation cycle, means are provided to automatically reduce ventilation air when extremes of cold are encountered. This indirectly shows up as materially reducing the heat loss of the building and may be of sufficient magnitude to allow the elimination of other means of heating.

We do not wish to suggest that all buildings would be adaptable to the heat conservation cycle; but, in general, the factors to look for in determining its feasibility, are:

1. Structures having large mass.
2. Structures having relatively small amounts of exterior glass.
3. Buildings having high-intensity lighting.
4. Buildings having considerable space with no exterior exposure.
5. Arrangements which include interior heat sources, such as basements, cafeterias, kitchens, etc.
6. Construction which utilizes insulation in roofs and walls to reduce heat transfer.

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TYPE UA	⅜	.484	.504	.690	.710	6	200	60	1500	460
	½	.622	.642	.820	.840	7	200	70	1000	365
	¾	.820	.840	1.030	1.050	10	150	70	850	420
	1	1.041	1.066	1.290	1.315	13	100	90	600	525
	1¼	1.380	1.410	1.630	1.660	16	50	70	375	430
TYPE EF	⅜	.485	.505	.690	.710	4	250	60	1500	390
	½	.620	.640	.820	.840	5	200	60	1000	325
	¾	.815	.835	1.030	1.050	6	175	70	850	375
	1	1.030	1.055	1.290	1.315	8	100	60	600	420
	1¼	1.370	1.395	1.635	1.660	9	100	80	375	360
	1½	1.575	1.600	1.875	1.900	11	50	55		
	2	2.020	2.045	2.350	2.375	14	50	75		
	2½	2.480	2.505	2.850	2.875	19	50	105		
	3	3.070	3.100	3.470	3.500	23	25	80		
	4	4.000	4.040	4.460	4.500	28	25	105		

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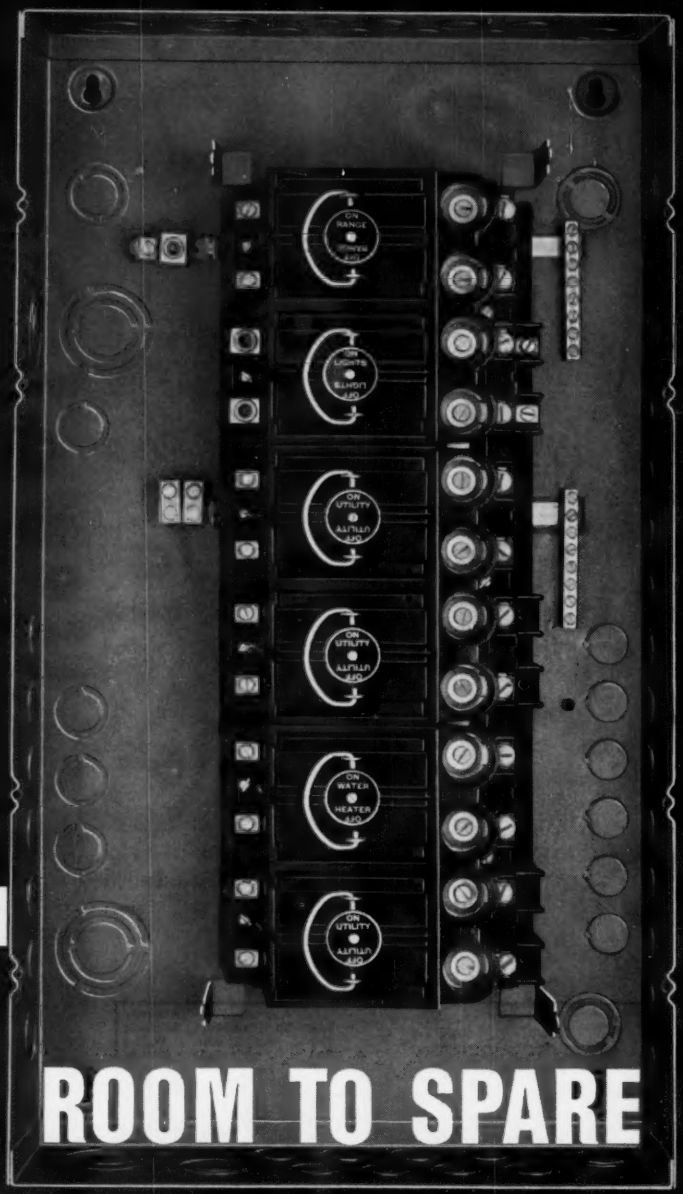

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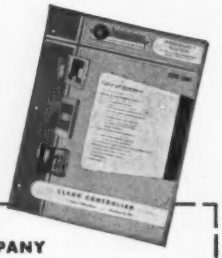

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Laminated Paper Used In Lighting Plenums

Flame-resistant foil-faced paper provides vapor barrier and high light reflectance.

A FOIL-FACED, reinforced paper, recently developed as a fire-resistant vapor barrier and adopted for many diverse uses, is now showing up as a liner for lighting plenums. American Light and Ceiling Company in San Francisco, one of the pioneers in the use of this material for plenums, has already made some impressive installations.

This flame-resistant vapor barrier material is called Pyro-Kure, and is made by American Sisalkraft Company, Division of St. Regis Paper Company. It was initially designed for applications where a vapor barrier is required; and as a facing material for insulation, it inhibits the transmission of water vapor, has high strength properties, and good reflectivity. It is made by laminating aluminum foil, bi-directional reinforcing fibers, and high quality kraft together under carefully controlled conditions. The adhesive used is a special substance. Under excessive heat, it emits a gas which extinguishes flame, and the material retains its flame resistant properties.

To date, this laminated paper material has been adopted for such uses as drapes in welding and paint spray booths, as a heat-reflecting backdrop, and as a concrete curing cover in ice rinks. The material contains no salts, and is flexible. There is no leeching, or danger of corroding adjacent metal surfaces. And it carries an Underwriters' label.

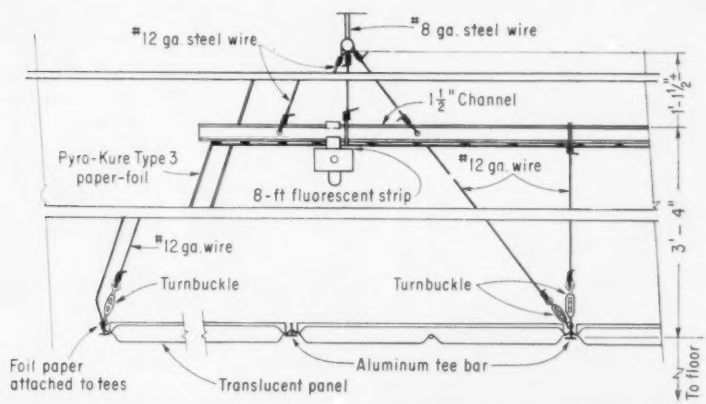
With the adoption of higher lighting levels for a wide range of lighting applications by the Illuminating Engineering Society in 1958, more lamps, and larger size lamps are being used to provide these levels. This results in more heat, and higher costs. Thus, plenums lined with Pyro-Kure help meet the heat problem, and also are more economical than other usual materials. But other details, such as the type of ceiling, the grid pattern, or the type and size of luminaires, must also be considered.

For example, in the University of California Library, 8-ft-long luminaires are suspended from a series of 1½-in. channels at 4-ft intervals from overhead steelwork, on No. 8 and No. 12 gage wire. Plenums are formed with the laminated, vapor-barrier reinforced paper (see sketch), attached to selected channels and extended down to aluminum tee members in the translucent panel framing. It is anchored in place with tape.

LAMINATED paper (Pyro-Kure) not only creates a plenum with fire-resistant vapor barrier, but also provides efficent reflecting surface for this large-area low-brightness recessed luminous ceiling panel. Installation is in the Poniatoff Building, Palo Alto, Calif.

A similar design is used in the recently constructed Poniatoff Building, in Palo Alto, Calif. The luminaire support design differs in detail only. The luminaires are supported from overhead wood joists with No. 8 gage wire, eye screws and bolts, and ice-tong type hangers on the luminaires, and mounted directly to the ceiling in other areas. The foil surface of the laminated paper diffuses and reflects 85% of the light back into the area.

With the growing trend to large-area low-brightness lighting elements, many specialized applications for this vapor-barrier paper can be found.

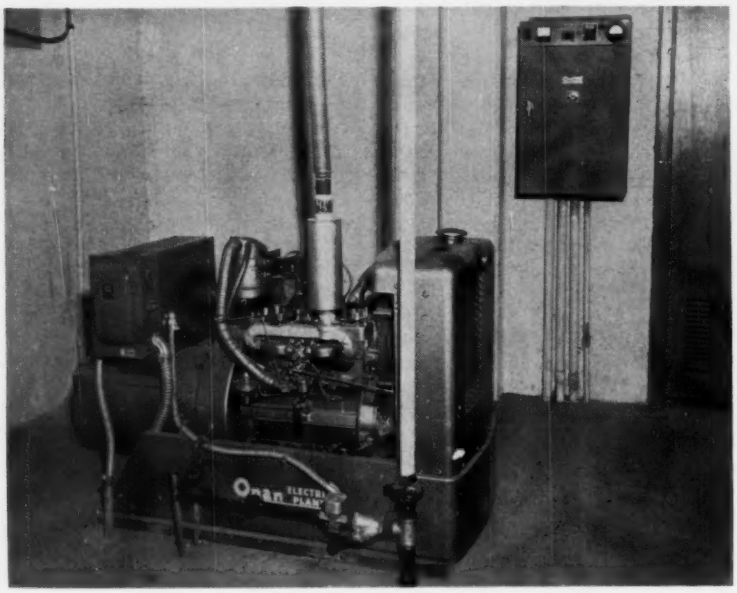


DETAIL shows how foil-faced reinforced paper with inherent fire-resistant vapor barrier is used to form plenum above translucent plastic luminous ceiling; also support method.

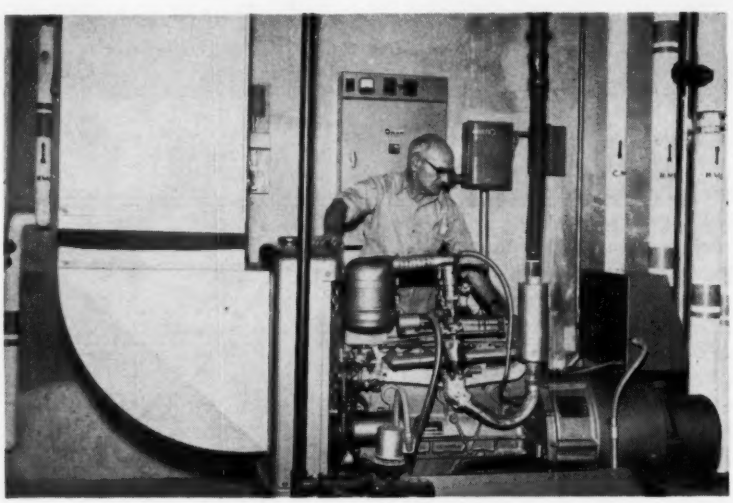
Generator Plants for Emergency Power

Students and faculty at Rider College in Trenton, N. J., have ample protection against the dangers and inconveniences of electrical power outages. Three emergency electric generating plants have been installed at the college —in the men's and women's dormitories and in the Student Union dining hall. Operating on natural gas, each of the two standby plants located in the dormitories are unhoused units providing 15,000 watts of 60-cycle, 120/208-volt, 3-phase, 4-wire, ac power. A 25,000-watt unit (also gas-driven) provides the same type of electric power protection for the dining hall.

Three times, since the emergency generating sets were installed in 1959, electrical storms have knocked out the main substation serving the campus and three times the reliable generator units have



15-KW GENERATOR is installed in the boiler room of the women's dormitory. Panel on wall in right background houses control equipment which automatically starts and stops the generating unit, as required by power loss in the main electrical system and transfers generator power to feed the buildings main panelboard.



25-KW POWER PLANT is installed in a mechanical room in the dining hall. Maintenance men check out the generators once each week. The extensive duct-work (at left) is necessary to direct hot air upwards through the roof and to provide fresh air when the generator operates.

automatically taken over the electrical load and operated essential equipment. One outage, in particular, lasted over three hours.

Electrically operated equipment in both dormitories, for which the standby plants provide power, include a 3-hp circulating water pump, the burner unit on a city-gas-fired boiler, a ½-hp sump pump, hot water heater and all emergency hall, ramp and exit lights.

In the Student Union a larger 25-kw standby unit can operate a walk-in refrigerator, a walk-in freezer, burner unit on boiler, circulating water pump, 13 fluorescent lamps and six exit lights.

Classrooms at Rider College are so wired as to permit easy hookup to an emergency generating set when future plans call for such equipment. Dormitories now being built will have emergency generating plants similar to the present equipment.

Variable Thickness Plastic Obtains Even Ceiling Brightness

Joseph Magnin's main San Francisco store has several physical features, all-too-prevalent in older structures, which complicate problems of lighting design. For example, in a second floor feminine sportswear department, ceiling heights are low, while such obstructions as structural beams, ducts and pipes preclude many desirable approaches to lighting.

In several previous attempts to attract customers to this section, to effectively highlight merchandise, and to create an impression of outdoor expanse, more than a ton of lighting equipment and wiring components had been installed without achieving a satisfactory combination of results.

Therefore, when Wen Garrett of Republic Electric was asked for suggestions, he proposed to first remove all existing lighting equipment to obtain maximum working heights; then to install a low-brightness luminous ceiling to create the desired sky-wide sunlit environment; then to suspend a series of unconventional "conversation piece" fixtures to add notes of gayness and color to the area.

As noted, the luminous ceiling consists of translucent 2- by 2-ft polystyrene plastic Cylindricell panels locked together with nylon clips and suspended 8½ ft above the floor. Suspension of individual

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CELLULAR CEILING in feminine sportswear department consists of translucent panels with plastic cylinders in tangent, toplighted by continuous rows of cool-white fluorescent lamps placed (by structural necessity) relatively close to upper surfaces of suspended panels. Even brightness of over-all ceiling is obtained, however, by addition of supplemental variable-thickness sheets of diffusing plastic placed directly on top of panels. Average intensity delivered to counter tops is 160-fc. Installation was proposed and installed by Wen Garrett (above) of Republic Electric Co., San Francisco.

panels is from their midpoints by means of unobtrusive threaded nylon tong hangers. Hangers in turn are rod-suspended from ceiling toggle bolts so that accurate leveling was easily achieved. Since panel patterns consist of numerous small cells in tangent, an element of texture detracts from smooth-surface plainness.

It is also of interest to note that, since the overhead plenum is shallow, rows of cool-white fluorescent lamps are positioned relatively close to upper surfaces of the suspended ceiling with rows installed 18 in. apart. This normally would result in noticeable variations in panel brightness. In this instance, however, variable thicknesses of diffusing plastic sheeting were placed directly atop cellular panels so that lamps are shielded from direct view, glare is minimized, light is diffuse in nature and brightness of panels is equalized over the lighted area from lamp row to row.

Auxiliary fixtures in this department are formed from imported Venetian glass bowls; lamps are 150-watt incandescents. And, over adjacent display cases (not shown in photo) additional lighting interest and intensity are provided by supplemental downlights and perimeter cove treatments.

The end result is an average illumination level of 160-fc on counters.

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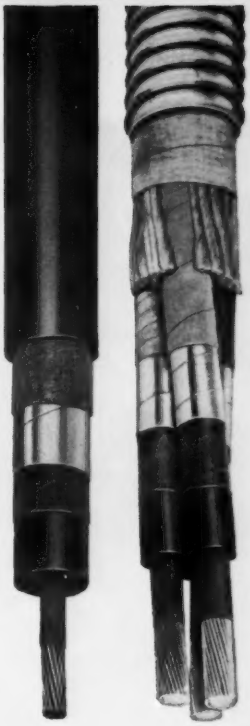


EVERY order for power cable calls for certain specifications to be met. At Circle, the point is not how well these specs are met – but rather how far *they are exceeded.*

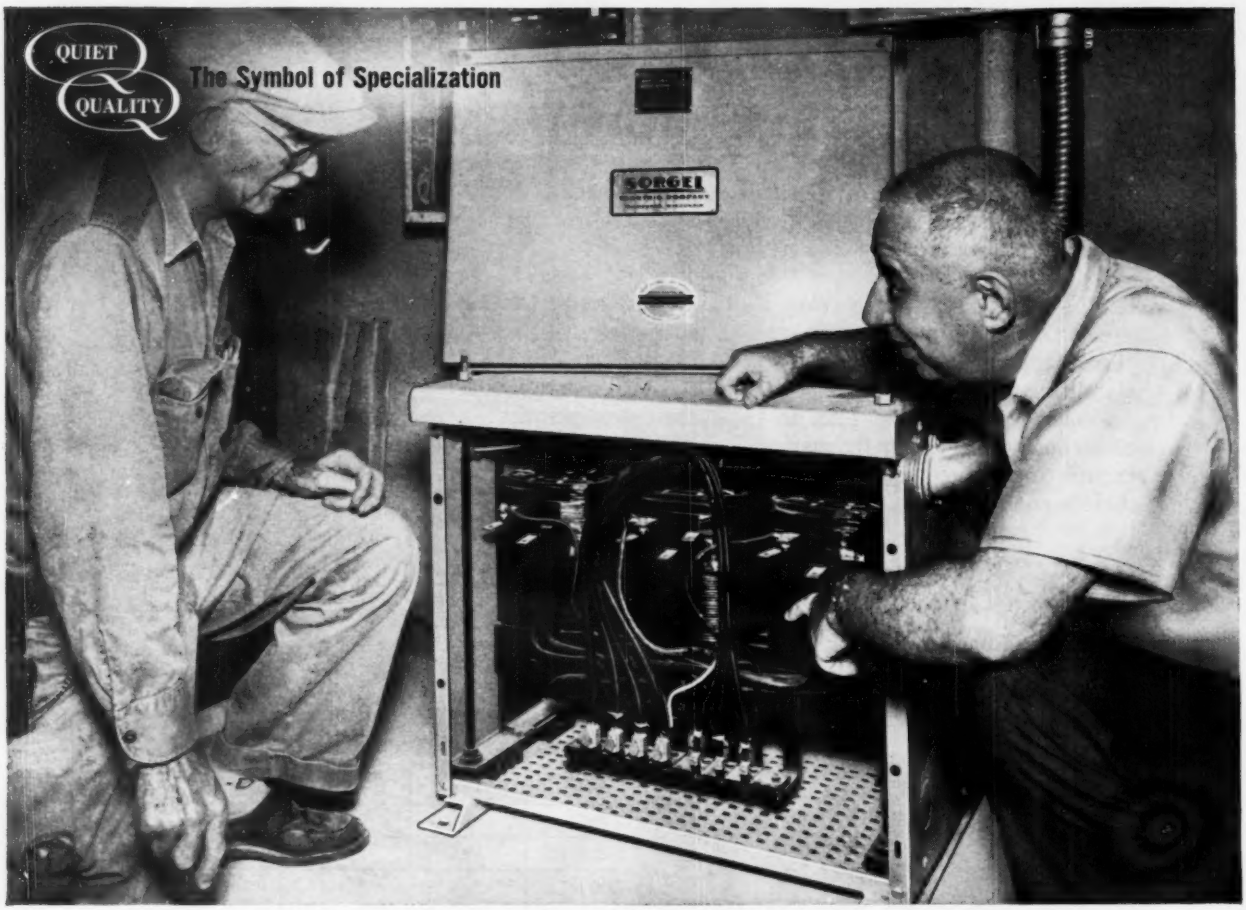
Example: the well-known "double-voltage" test as required by IPCEA-NEMA. The table below demonstrates *one of the ways* Circlesheath Type RR power cable exceeds specs to give users maximum performance. Circlesheath also excels in ozone resistance, long-term stability and other essential power cable requirements.

Power cable reliability is no haphazard achievement. It requires continuous supervision by men who not only care enough but know enough to produce the very best. Specify Circle on your next job – there's no finer cable made.

CIRCLE WIRE & CABLE CORP.
SUBSIDIARY OF **CERRO CORPORATION**

PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities.
Rubber Covered Wires & Cables • Varnished Cambric Cables • Plastic Insulated Cables • Neoprene Sheathed Cables • "CIRTUBE" EMT

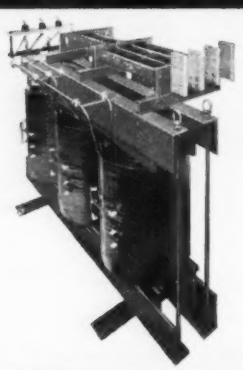
CABLE SIZE	RATED VOLTAGE	DOUBLE AC TEST VOLTAGE	CIRCLE B'KDN VOLTAGE	MAXIMUM STRESS IN VOLTS PER MIL
2 AWG	5KV	28KV	48.3KV	454
1/0 AWG	5KV	28KV	40.3KV	356
500 MCM	5KV	31KV	44.6KV	307



Sam H. Deane, a 75-year-old pro, pictured left above with Sorgel representative, W. Chester Smith, took out his union card in Bluefield, West Virginia in May of 1915. Sam has been an active electrician ever since. In his experienced opinion, backed up by his fellow workers and his boss, John Potter, president of Diplomat Electric, Inc., Ft. Lauderdale, Florida, Sorgel transformers like this 75 KVA, 3 phase unit, are the finest in the field. Sam says the quiet level of operation, in addition to ease of installation, is one of the big advantages of Sorgel, especially in office, school and hospital buildings. He is an active member of IBEW Local 728 and installed Sorgel Transformers for Diplomat in the newly completed Broward County Court House job, in Ft. Lauderdale.

1/4 KVA
TO
10,000 KVA,
ALL STANDARD
AND
INTERMEDIATE
VOLTAGES
UP TO
15,000
VOLTS

SORGEL HAS A DRY-TYPE



True quality assures you of dependability and low cost operation, and is especially important in the heart of your entire electrical system. This 500 KVA, 5 KV class is a typical Sorgel core and coil unit for a unit sub-station.

Sorgel provides the most liberal designs and a coordinated system of either Class B, F, or H insulation, with the most effective use of quality materials to assure continuity of service. All units meet or exceed ASA, NEMA and AIEE standards. Shown above is a special 25 KVA Globar Furnace Transformer.

A Case History Report...

A FLORIDA ELECTRICIAN WITH 45 YEARS OF EXPERIENCE PREFERS SORGEL FOR 5 REASONS

A professional of 45 years knows his electrical products and these are Mr. Sam Deane's comments on Sorgel dry-type transformers, pointing up the economy and advantages to people like yourself who buy, specify and install transformers.

Fact No. 1—"It's easy to make good tight connections in Sorgel units because the terminations are securely anchored and there is ample hand working room. Another thing, these units aren't squeezed and jammed tightly into the case, which would be dangerous and would slow down installation time."

Fact No. 2—"When we begin installing a Sorgel unit, everything is ready for wiring. Their factory assembly, wiring and testing speed up our whole installation operation."

Fact No. 3—"The case design, location of knockouts, interchangeable wall or floor mounting and the built-in lifting eyes make positioning and securing a breeze for the contractor."

Fact No. 4—"The ventilation design is especially good as it prevents accidental access to live terminal parts. I also like the front cover design because it's easy to remove by means of simple captive bolts."

Fact No. 5—"Last, but not least, you are really proud to have installed a Sorgel unit because of its neat appearance. It definitely is the quietest in the field, never requires maintenance."

Ask your own area electricians and see if they don't agree with this professional of 45 years' experience on the Quiet Quality features of Sorgel units. It's advantages like these that are causing more and more consulting engineers, plant engineers and contractors to specify and insist on Sorgel day in and day out.

Contact your nearest Sorgel Sales Engineer for additional reasons why Sorgel units are truly your most economical buy —as quality pays, it doesn't cost.

SORGEL
SOUND-RATED DRY-TYPE
TRANSFORMERS

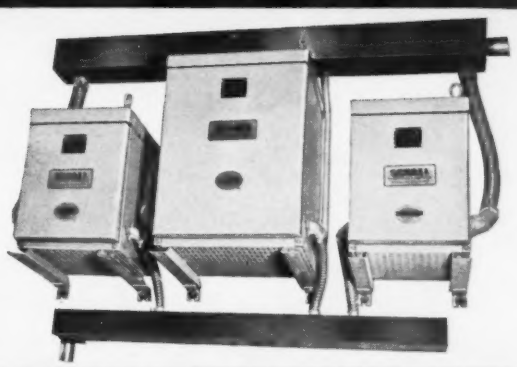
SORGEL ELECTRIC COMPANY

Since 1916 the pioneer in the development, manufacturing and application of sound-rated dry-type transformers

836 WEST NATIONAL AVENUE • MILWAUKEE 4, WIS.

Experienced sales engineers in principal cities

TRANSFORMER FOR YOUR EVERY NEED



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- ☐ 611—Transformer Line
- ☐ 960—Substations
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Name_____

Title_____

Address_____

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State_____

Taking full advantage of Sorgel's interchangeable wall and floor mounting design, Diplomat Electric first used the built-in lifting eyes on these Sorgel units to raise them exactly to the selected mounting position nine feet above the floor. This unique bank of one 30 KVA and two 15 KVA units took voltage from a 480Y277 volt primary and provided secondary circuits of 120/240 volt single phase and 240 volt three phase.

Introducing
a magnificent
NEW line of
industrial lighting
fixtures from
Sylvania...

The

Power-V

Series

Today you can specify or purchase a wide variety of industrial lighting fixtures at varying prices. Many of these fixtures have particular features that make them advantageous to use in specific applications.

But now from Sylvania comes a complete and versatile line of NEW industrial fixtures . . . a series that includes all of the features you normally look for in a fixture plus outstanding quality points all its own.

THIS IS SYLVANIA'S POWER-V SERIES

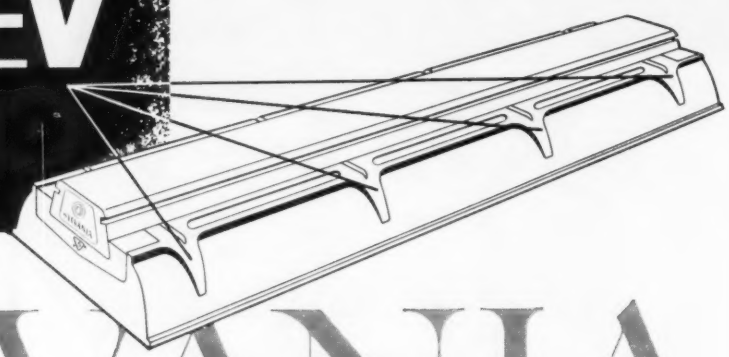
A ruggedly-built series that shrugs off accidental abuse . . . that features a new concept of design providing a wider and deeper embossed reflector for better lighting yet maintaining a low silhouette for handsome appearance.

Power-V units are designed to meet RLM specs and can handle all types of the powerful 1500 ma extra-high output lamps.

The Power-V Series is simple to install . . . easy to maintain . . . provides long, trouble-free service . . . yet is modest in cost.

If you have any interest in industrial lighting, you should learn about Sylvania's Power-V Series. For additional information, write to:

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, West Virginia



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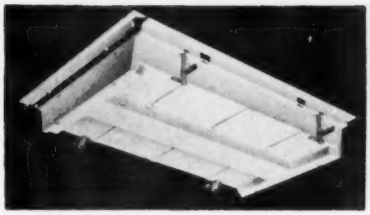
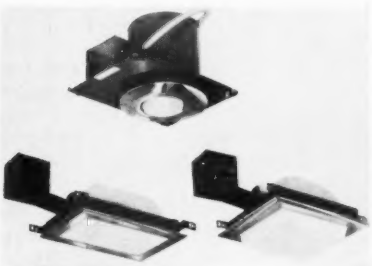
Product News



Luminaire (1)

A new line of recessed commercial fluorescent luminaires, called the Mark II Mainliner, is available. The types offered are wide flange, grid and T-bar. With each type there is a choice of louver, diffuser, or lens shielding. Depending on choice of shielding, available materials include glass, metal or plastic. Sizes range in width from 1 to 4 ft and in length from 2 to 8 ft. Round fixtures are available with 2-, 3-, and 4-ft diameters.

Westinghouse Lighting Division, Edgewater Park, Cleveland, Ohio



Recessed Fixture (2)

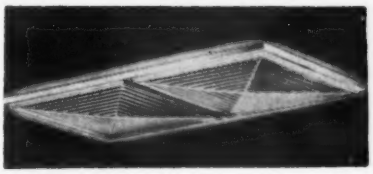
Designated S-R-O (square-round-oblong) the new line of recessed fixtures comprises 13 housings and 36 different fronts including flat and drop bowl lenses, louvered, conical, skirted, eye-ball, pinhole and adjustable spot. To permit flexibility, all housings can accommodate several fronts. The new round U-All (Universal-All lighting lenses) housing can be used with any of 67 different fronts and finish combinations. All fixtures are listed by UL.

Emerson-Pryne, Emerson Electric Co., 8100 Florissant, St. Louis 36, Mo.

Safety Device (3)

A switch locking cover attachment with Yale lock is tamperproof. Available in master keying and straight keying systems, the new device can be adapted to virtually any situation where switch control is necessary or important. The lock comes with two duplicate keys. Attachment can be quickly and easily installed over an existing flush toggle switch—except the interchangeable type—without any change in wiring. It can be keyed in four different ways.

Harvey Hubbell Company, Bridgeport, Conn.



Lighting Fixture (4)

A new surface-type lighting fixture that seems to "float" on the ceiling has been introduced. Called "Tiara," it is ideal for stores, offices, schools, etc. Depth of unit is 1-⅞ in. at outside edge and 3-⅛ in. where fixture's lenses taper to deepest point. It measures 25 by 50 in. and uses 4-ft fluorescent lamps. Ideal for both new construction and relighting, the fixture's multiple knockouts permit end-to-end, side-by-side or end-to-side installation. It can be installed as a 2- by 4-ft single fixture, as a 4- by 4-ft double fixture, or can be used to create large luminous elements. Booklet is available.

Day-Brite Lighting, Inc., 6260 North Broadway, St. Louis 15, Mo.

Switch (5)

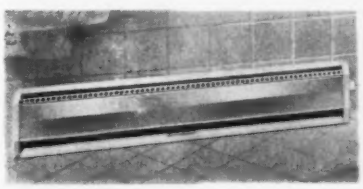
Introduction of a new watertight, subway type, 3-pole oil switch (M-35) has been announced. The 5-kv, 300-amp switch is able to withstand momentary and short time currents to 25,000 amps. It has porcelain insulators, laminated copper brushes and stud and contact blocks. The new nonautomatic subway oil switch, designed for disconnect service on underground distribution systems, is suitable for wall mounting, manholes and in subways for sectionalizing of lines, switching transformers, and similar services where positive and safe operation is necessary without frequency adjustment and inspection.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.

Lighting Unit (6)

A new line of aluminum, recessed and surface rounds with prismatic Amcolenses and white Amtex glass diffusers, is available. Diffusers are recessed above the ceiling. Face trim and housing are aluminum. Plaster frame is cadmium plated steel. Bulletin RR1-961 is available.

Art Metal Lighting Div., Wakefield Corp., 1814 East 40th St., Cleveland 3, Ohio



Baseboard Heater (7)

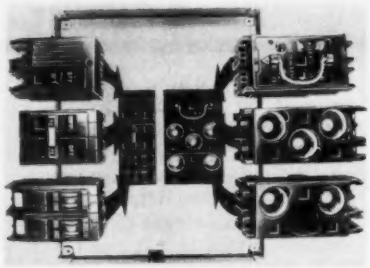
A convection baseboard unit is especially designed for use in bathrooms. A built-in thermostat automatically regulates bathroom comfort level. A thermal cut-out prevents overheating should airflow accidentally be restricted or cut-off. The 660-watt baseboard is available in 120-volt and 240-volt models. The 12-lb units are 34½ in. long, 6¾ in. high and 2¼ in. thick.

Hunter Division, Robbins & Myers, Inc., Memphis, Tenn.

Switch (8)

A new lighted handle rocker-type switch has been developed. It is rated at 15 amps, 120 volts, ac. It is available in Despard, interchangeable type with wide rocker to fit Despard plate openings, or in strap type with narrow rocker for use in standard switch plates; in single pole or 3-way. A neon lamp in back of translucent rocker button gives off a soft glow when switch is in OFF position. When ON, rocker is not lighted.

Pass & Seymour, Inc., Solvay Station, Syracuse 9, N. Y.



Service Entrance Line **(9)**

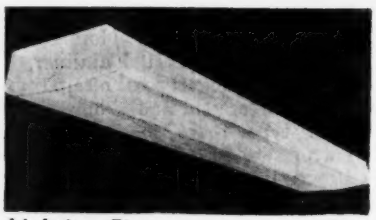
New 4-IN-1 breaker/fuse panels now available provide a service entrance enclosure which accepts both plug-in circuit breakers and plug-in fusible units. The line makes it possible to install both breakers and new G-E plug-in fuse blocks in the same panel. In addition, each panel has dual mounting provision. Selection is easier as 29 panels cover the full range of service-entrance requirements from 100 to 200 amps; 12 to 40 circuits; flush, surface or raintight; circuit breaker or fusible. Pullers are available in 30- and 60-amp ratings for both main and branch-circuit protection. Two units are offered for 15- to 30-amp plug fuse circuits. One unit has space for two plug fuses; a second unit has space for three. All panels are UL listed and meet NEC non-interchangeability requirements. Ratings and models include 100, 125, 150 and 200 amps; single-phase, 3-wire; main-lugs-only; split bus and main disconnect.

General Electric Company, Circuit Protective Devices Department, Plainville, Conn.

Floodlight **(10)**

New multi-purpose floodlight called "Generalflood" has been added to the Intenso line of floodlights. Features include high efficiency, easy installation, convenient service from front or through "swing-over" design from rear, self-centering inner reflector and special filter wick to keep reflector and cover glass free of dirt and condensation. Two reflector diameters are available. The 14-in. unit accepts 300- to 500-watt incandescent or 250-watt M-V lamp. Larger 16-in. unit accepts 750- to 1500-watt incandescent, or 400-watt mercury-vapor lamps. Bulletin GF 860 is available.

Appleton Electric Co., 1701 *Wellington Ave., Chicago* 13, *Ill.*



Lighting Fixture **(11)**

A new wraparound fluorescent lighting fixture built for surface mounting, in either individual or continuous row patterns, has been announced. The "Stylus" fixture is designed in shallow modern styling. It carries a totally enclosed steel top-plate, and return end caps provide a finished appearance and prevent "light leak" from the ends. "No-drip" CBM ballasts are featured in the fixture. Silver-plated lampholder contacts assure positive lamp starting. It uses two 40-watt rapid-start lamps. Unit is listed by UL.

Sylvania Electric Products Inc. Box 831, *Wheeling, W. Va.*

Signal **(12)**

A new line of cordless, loudspeaker telephones for apartment houses, featuring a one-circuit system for transmission of audible signals, has been announced. The conventional low-voltage telephone bell or buzzer circuit is completely replaced by an electronically-produced Transitone signal. The electronic signal can be easily adjusted from a soft to a loud tone to suit the individual apartment occupant. Three systems are available. They are a single conversation system; two conversations at a time; and a multiple conversation type which utilizes a manned telephone switchboard. The latter provides complete intercommunication between any number of points in a building and can be used for simultaneous conversations.

Auth Electric Company, Inc., 34-20 45*th St., Long Island City* 1, *N. Y.*

Fast, easy to handle...even overhead!

J-M DUTCH BRAND PLASTIC ELECTRICAL TAPE IN THE BRAND-NEW DISPENSER makes taping faster, easier than ever. Here's why:

FAST, EASY-TO-USE DISPENSER gives you ten important advantages. And—because this new Dutch Brand dispenser helps electricians "tape and tear" in one simple operation—a better-looking, longer-lasting job is assured.

STRONG, DEPENDABLE TAPE is thin and flexible... meets the industry's highest standards. What's more, J-M Dutch Brand Plastic Electrical Tape has uniformly high dielectric strength . . . provides outstanding resistance to acids, alkalies, oil, solvents, fungus, bacteria and gases. In short, *the finest plastic electrical tape you can buy carries the Dutch Brand name.*

SEE FOR YOURSELF! Get all the facts on dependable J-M Dutch Brand® Plastic Electrical Tape in the handy new dispenser from your Dutch Brand distributor. Or write Dutch Brand Division, Johns-Manville, Box 359, New York 16, N. Y. In Canada: Port Credit, Ont. Cable: Johnmanvil.

TEN IMPORTANT ADVANTAGES!

1. Permanently shielded cutter! **2.** No moving parts to snag hands, clothes! **3.** Can't dull or clog! **4.** "Tape-and-tear" with one hand! **5.** Special "grip-strip" for faster starting! **6.** Full 66′ of finest plastic electrical tape made! **7.** Preloaded . . . ready to go! **8.** Protects tape against dirt, grease! **9.** Big center hole for easy handling! **10.** No extra cost!

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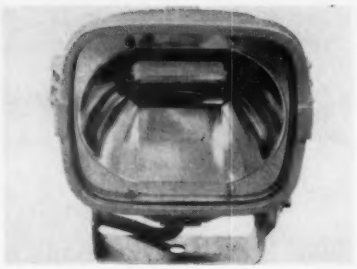
JOHNS-MANVILLE JM PRODUCTS



Floodlight (13)

A new floodlight for high-intensity area illumination using Quartzline lamps, has been announced. Available in both 500- and 1500-watt sizes, the new quartz-iodine units are intended for use in large areas where their wide horizontal beam and narrow vertical beam with sharp cutoff make fewer poles necessary for adequate illumination. Both sizes of the incandescent floodlights maintain cool operating temperatures and contain a built-in fuse to prevent violent lamp failure at end-of-life. They may be mounted directly on wood cross arms or drilled steel cross arms. With the proper selection of adapter, they also may be mounted on pipe, wall or other surface mounting.

General Electric Co., Schenectady 5, N. Y.

Lowering Device (14)

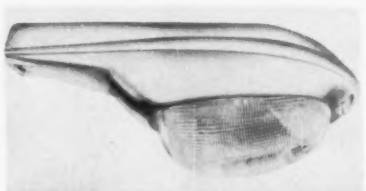
A new luminaire lowering mechanism permits ground level maintenance on street lights, area lights and floodlights. The new UL-listed device is available on a wide range of aluminum lighting standards, single- and twin-arm models with truss arms up to 15 ft long. Device can be used to support pendant-type incandescent or mercury-vapor luminaires and bail or yoke suspended single or twin floodlights. Catalog LM-1 is available.

Pfaff & Kendall, 84 Foundry St., Newark 5, N. J.

Boxes and Troughs (15)

For use outdoors where wiring and controls must be protected from the weather, new raintight screw cover boxes and troughs are now available in the Boss line. Both are constructed of galvanized sheet metal, finished in gray enamel. Boxes come in 11 standard sizes, ranging from 6 in. by 4 in. by 4 in. to 18 in. by 12 in. by 6 in., with knockouts in bottom. Troughs, with knockouts in bottom, come in 12 standard sizes ranging from 4 in. by 4 in. by 12 in. to 6 in. by 6 in. by 72 in.

Huenefeld Co., 2701 Spring Grove Ave., Cincinnati 25, Ohio



Luminaire (16)

New luminaire for arterial streets or highways is offered with built-in ballast and adapter for photoelectric control. Called the "Unitized Endoval," the new 2600 Series luminaire is designed for wide, heavily travelled streets and is offered with or without built-in constant-wattage or high-power-factor reactor ballasts. It is also available with a mounting adapter for EEI-NEMA standard plug-in locking-type photoelectric control. It uses 250- or 400-watt mercury lamps. Adjustable socket positions produce ASA-IES Types II, III, or IV with proper choice of lamp. Unit is designed to fit either 1¼-in. or 2-in. pipe mounting arm. Bulletin No. 700-15 is available.

Revere Electric Mfg. Co., 7420 Lehigh Ave., Chicago 48, Ill.

Instruments (17)

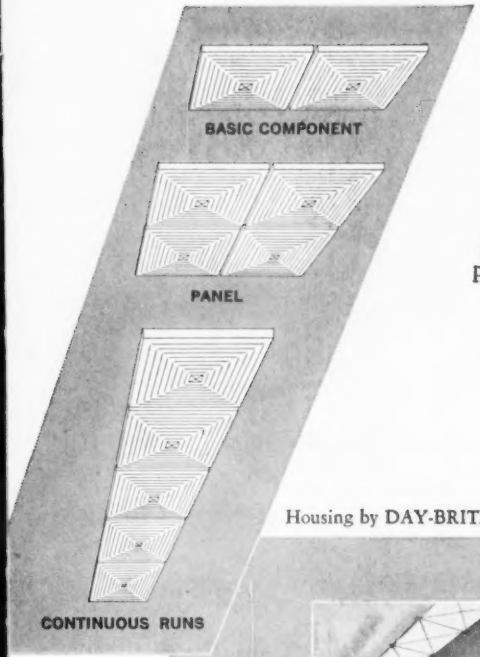
Portable ac and dc ammeters and voltmeters that feature taut-band suspension frictionless mechanism are now offered. Moving element of taut-band suspension system is suspended between bands of high-strength metal ribbon which are supported on springs at each end. Scale lengths are 6 and 10½ in. respectively, with corresponding scale arcs of 100 and 240 degrees. Two-tone gray case features an insulated retractable handle.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

HOLOPHANE DEVELOPS A TOTALLY NEW LUMINAIRE

Controlled Illumination Contoured to Any Area...

HOLOPHANE SERIES 6600
Surface-Mounted



To meet the critical challenge of the "modular era" Holophane Engineers have developed Series 6600—introducing a distinctive new luminaire and a startling concept that permits almost unlimited flexibility of design.

Using the basic 2 ft. x 4 ft. component, containing acrylic plastic CONTROLENS®, these luminaires can be installed as single units—or aligned for continuous runs—or massed in panels—or tailored to go around corners. Their great versatility satisfies the designer who seeks one luminaire, for all lighting requirements throughout an entire structure.

Add to these, the quality features found in all Holophane lighting products: prismatic control for highest utilization of light, visual comfort, enduring performance, economy in installation and maintenance. Write for data.

HOLOPHANE COMPANY, INC.

Lighting Authorities Since 1898

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THE HOLOPHANE CO., LTD., 418 KIPLING AVE. SO., TORONTO 18, ONT.

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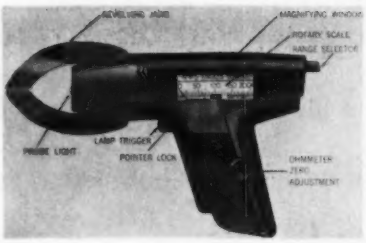
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

Cut corners with flexible USS Armorlokt Cable

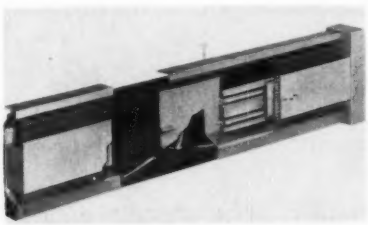
Remember your last conduit job . . . all the time and work needed to install junction boxes, not for new circuits but just so the cable could be pulled around corners? And the longer the pull, the more boxes you needed. USS Tiger Brand Armorlokt Cable could have been installed in approximately one-half the time and eliminated all that expensive pipe fitting and bending. ■ Armorlokt installs as easily as ordinary cable—yet it protects as well as rigid conduit, and sometimes even better because Armorlokt is flexible and "rolls with a punch." You can install it anywhere . . . up, down, across walls, buried in the ground, suspended in trays or on cable rings, indoors or outdoors. Armorlokt can be installed in long lengths, because its flexible construction permits easy and quick bending around corners, I-beams, or any other obstruction. And you can easily splice into Armorlokt Cable, anywhere along the entire length. ■ Armorlokt has a higher current-carrying capacity than the same size conductor in conduit because heat is quickly dissipated, not trapped inside. Corrosive atmospheres are no problem. Armorlokt is available with galvanized steel, stainless steel, aluminum or bronze armor. It's also available with an Ampyrol (PVC) jacket, in black or colors for easy identification. You can order Armorlokt with almost any kind of insulation, including varnished cambric, rubber, or asbestos up to four inches in diameter, rated 15,000 volts. ■ There's a standard USS Tiger Brand cable for every special job. For the complete story on Armorlokt Cable or any other type cable, call our nearest sales office or write American Steel and Wire, Dept. 1409, Rockefeller Building, Cleveland 13, Ohio.



Meter (18)

The "Pistolmeter" simplifies measurements in tight spots. Revolving jaws at the muzzle-end of the Pistolmeter permit their insertion into cramped gutters and cable boxes at any convenient angle and the trigger-operated probe light at the meter's end ensures safe handling. A locking device on meter pointer enables user to make his reading after the Pistolmeter has been removed from the tested conductor. This meter has a color-coded rotary scale with four current ranges — 0-15/60/200/600 amps; two voltage ranges — 0-150/600 volts, and two ohmmeter ranges—0-500/5000 ohms. Unit is furnished with test leads, a battery charger and a holster.

Federal Pacific Electric Co., 50 Paris St., Newark, N. J.



Baseboard Heaters (19)

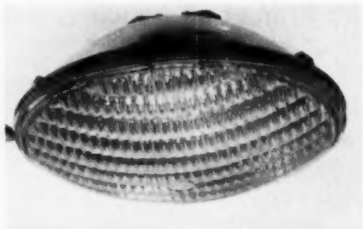
Perimeter baseboard heaters with a 277-volt rating are available. Another feature in this line is the ¼-in. mesh grill at top and bottom of heater. Heaters have a heat output of 250 watts per ft, but the maximum panel face temperature is 130°F. Metal enclosure is of rigid design, with front panel of heavy metal equivalent to 20 gauge steel. It can be adapted to any angular contours.

Wesix Electric Heating Co., 390 First St., San Francisco 5, Calif.

Service Lights (20)

The new LV-Series service lights provide 6-volt power and light source for positive protection from electrical shock. They are designed for use in damp areas or where grounding possibilities are ordinarily present. Units operate from a 110/120-volt line. They are supplied with 6 ft of yellow rubber cord with plug on input side of a neoprene encased transformer, which steps the voltage down to 6 volts, 25 ft of yellow rubber on output side of transformer and lampguard. Models with reflectors or vaporproof glass globes are available. They are built to accommodate 75-watt, 6-volt lamp bulbs. Literature available.

McGill Manufacturing Co., Inc., Valparaiso, Ind.



Lamp (21)

A new 12-volt lamp for underwater use in swimming pools, fountains and elsewhere, is rated at 500 watts. The lamp is 8 in. in diameter and resembles a sealed-beam auto headlamp. It throws a wide beam of light under the water, about 60° horizontally and 30° vertically, and has a peak beam candlepower of about 20,000. Although the bulb is made of hard glass, which is resistant to thermal shock, it is recommended that the lamp be mounted in a water-tight housing having a cover plate.

General Electric Co., Nela Park, Cleveland 12, Ohio

Controls (22)

A complete line of ac-supplied all-electrical variable speed controls for dc motors from ½ hp through 3 hp in 15 standard "off-the-shelf" models are in production. Designed as "VT" series, the controls operate from standard 50/60 cycle ac single phase 115 volts, or 230 volts in 1 hp and larger models. They are easily connected to any standard dc motor, shunt or compound wound, and provide infinitely-variable speed control from zero to maximum motor rpm in either direction (reversing switch is included in control). Standard and remote controls models are available.

Pacific Industrial Controls, Inc., 1212 Sixth St., Berkeley 10, Calif.

New! SPANG BLUE STAR CONDUIT

Now—from SPANG comes a new improved galvanized rigid steel conduit. Here's what it offers you:

NEW—*best thread protection available against rust*

. . . a smooth, uniform zinc galvanized coating on every ridge and valley of every thread . . . easy coupling—can be hand tightened the whole way . . . no thread chasing . . . no excess zinc . . . Preece-tested to assure quality and dependability.

NEW—*double galvanized coating on the conduit for extra corrosion resistance*

. . . inhibits white rust formation . . . eliminates flaking of finish . . . has that fine SPANGLEAM appearance.

NEW—*better packaging for easier handling*

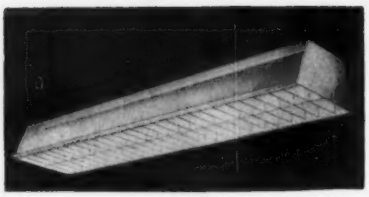
. . . bundled in steel strapping in sizes up through 2" . . . shipped on a one-ton rectangular lift for convenient transit by lift truck...cuts handling costs—makes inventory easier.

* * *

Save installation time, get top protection against rust and corrosion with new SPANG Blue Star Galvanized Rigid Steel Conduit. See your nearby SPANG Distributor for complete details and samples.

SPANG Blue Star Conduit is one of the many fine products produced by *National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Penna.*

ARMCO National Supply Division



Troffers (23)

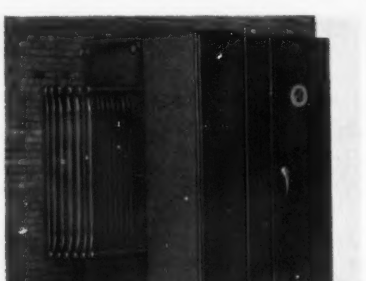
New line of parabolic Alzak troffers are designed to accommodate two lamps. Troffers have contoured aluminum sides and a contoured center wireway cover that comprises the twin reflective element. Available in 48-and 96-in. lengths for T12 or T17 lamps, the troffers are also made in 5-ft lengths for the low brightness T17 lamps. Reflective elements are of aluminum, and wiring channel is made of 20 gauge steel.

Electro Lighting Corporation, div. of Electro Consolidated Corp., 1535 Paulina St., Chicago 8, Ill.

Emergency Lighting (24)

Instantaneous and automatic operation, electrical supervision and automatic recovery are features of two new 32-volt emergency lighting systems introduced for incorporation in all types of nonresidential buildings. Systems have built-in "supervisory" circuits which report immediately any disarrangement in the system. Power is provided by Flexlab nickel-cadmium batteries which are non-acid. Catalog is available.

Standard Electric Time Co., 89 Logan St., Springfield, Mass.



Power Center (25)

A new line of 3-phase power centers has been developed specifically for shopping centers, industrial plants, schools and similar applications. Designed for use with underground primary feeders, the new "Power Supply Centers" permit the elimination of fences and overhead structures. Sizes range from 750 through 2500 kva, 15 kv and below. Standard centers include a 55C-rise, oil-immersed, load-center transformer with standard load-center accessories. Terminal compartments, with hinged doors, are provided for both high- and low-voltage connections. All live parts are enclosed in weatherproof, tamperproof compartments, which may be padlocked. Primary cable entrance is from underground, with either top or bottom cable entrance on the secondary.

Pennsylvania Transformer Div., McGraw-Edison Co., Canonsburg, Pa.

Supervisory System (26)

A simplified supervisory system, called Unicode, handles the control and indication of a single device at a remote station. At each remote station Unicode will close and trip one device such as a circuit breaker or motor contactor, while at the master station continuously indicating with a lamp whether the device is open or closed and sounding an alarm when the position changes. Up to ten remote stations can be controlled from a single master station unit over one pair of telephone-type line wires.

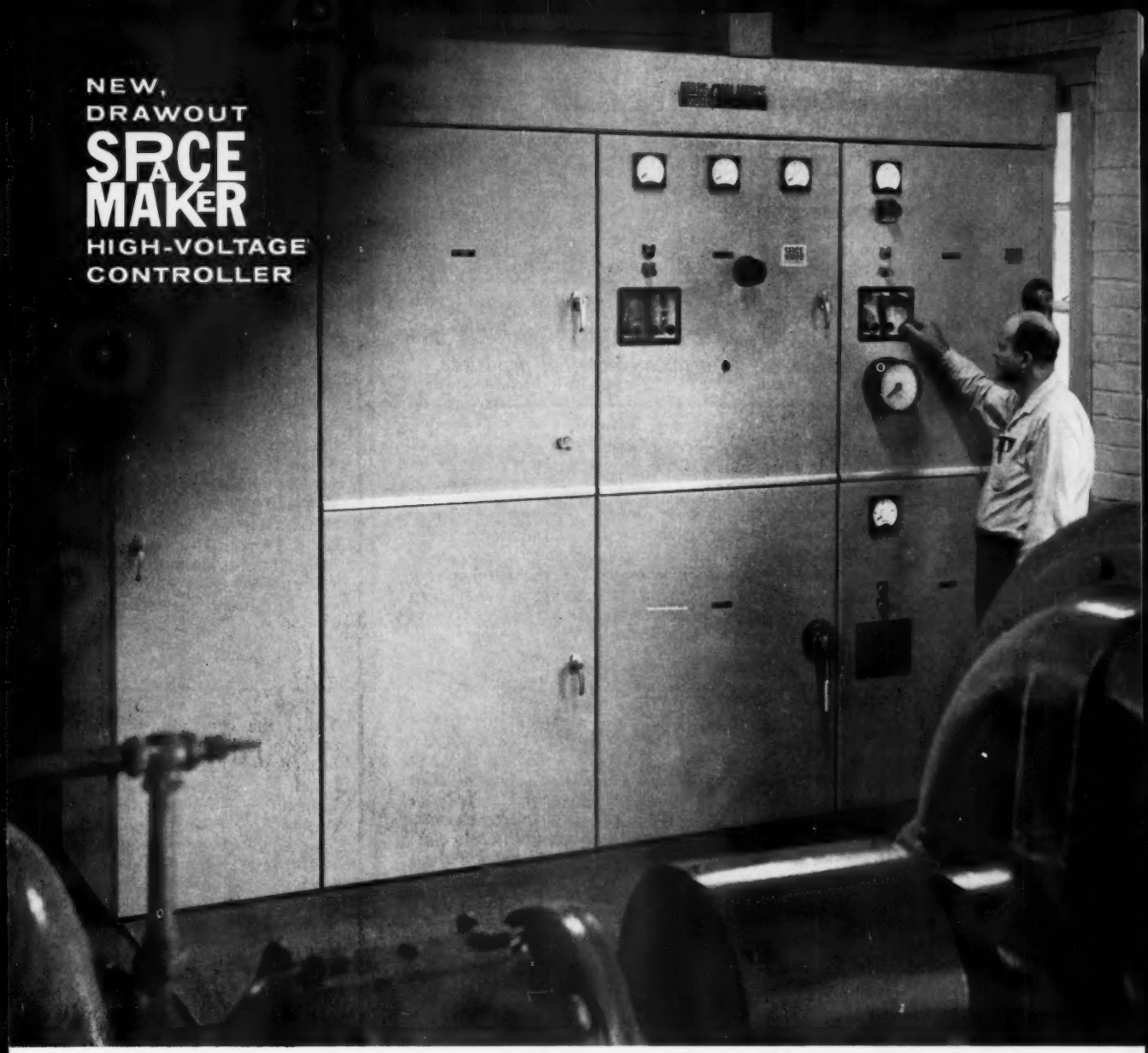
Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Lighting Fixture (27)

New incandescent lighting fixtures, called the Astralume recessed series, feature a shallow silhouette look designed for modern architecture. Glass extends less than 3 in. below ceiling. Fixtures are available in round or square units and utilize handblown, Thermopal glass with no frames, latches or visible means of support. The Astralumes come in the following sizes: round, 11¾ or 16 in. in diameter; square, 12 or 14⅛ in. in diameter. The prewired, recessed housing allows vertical lamping and the use of lamps as high as 300 watts where desired. The 27-in. junction box is retractable and permits access from above, below or inside the housing.

Prescolite Manfacturing Corp., 2229 Fourth St., Berkeley 10, Calif.

NEW,
DRAWOUT
SPACE
MAKER
HIGH-VOLTAGE
CONTROLLER



SPACEMAKER control at Stratman pumping station: (from left to right) 1. Auxiliary controls. 2. Fused disconnect switch (upper) and spare cubicle (lower). 3. Synchronous control. 4. Wound-rotor control (upper) and squirrel-cage control (lower).

New SpaceMaker control eliminates costly floor-rebuilding for St. Louis County Water Company

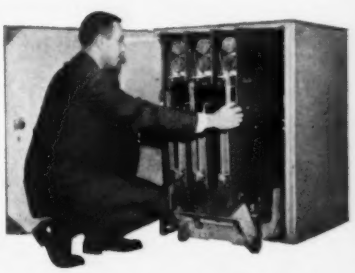
Privately owned St. Louis County Water Company serves more than 160,000 customers in a 225-square-mile area adjoining St. Louis, Mo. This progressive utility recently replaced an obsolete panelboard in a "cramped" pumping station with new *SpaceMaker* high-voltage motor control.

Allis-Chalmers new, exclusive two-high design enabled the utility to install all needed controllers in a single lineup. This permitted use of existing conduit without changes — thus saving cost of conduit relocation and floor reconstruction. Other controllers would have required a back-to-back layout.

Equally important: the single lineup of *completely* drawout front access controllers saved valuable aisle space.

To learn more about the *exclusive* cost-cutting, space-saving features of *SpaceMaker* control, contact your A-C representative or write **Allis-Chalmers,** Industrial Equipment Division, Milwaukee 1, Wis.

SpaceMaker is an Allis-Chalmers trademark.



Single cage controller in compact enclosure measuring 45 inches high, 36 inches wide and 32 inches deep.

ALLIS-CHALMERS A-1532

Sell the Electrical Man

all three parts of him!

The Electrical Man who designs, installs and maintains electrical systems also selects, buys and approves electrical products.

Design

The design function and its specifying power is governed by the project requirement plus installation and maintenance considerations. Strong influences are exerted by product performance and reliability as well as the consultant's own awareness of a product's or a brand's existence.

Consulting Electrical Engineer

He is either self-employed, or works for an independent consulting engineering firm, architect, builder or general contractor. He can be in the power sales department of a utility, with the government, or in a federal or municipal inspection department. He must know how to install and maintain a system to design it properly. Even though he performs only one of these three functions, he must know all three well.

Electrical Contractor

He operates an independent enterprise working in commercial, industrial and residential fields. He often employs engineers, estimators, project supervisors, and construction specialists — all in addition to electrical journeymen. He and his men must know all about the problems of designing and maintaining the systems they construct because many times they perform all three of these functions.

While the contractor's primary concern is installation, he must often design all or part of an electrical system as well. He must have much of the knowledge and skill of a consulting engineer if he does not employ an engineer on his staff. His design is very strongly influenced by maintenance considerations.

Plant Electrical Man

He is a full-time employee concerned with his organization's electrical systems and often responsible for total on-site maintenance as well. He must know all about the problems of designing and installing the system he maintains because many times he performs all three of these functions.

The plant electrical man must frequently plan his own electrical systems. His control over an outside consultant's design is significant. He is influenced mainly by product reliability and its economical performance.

The Electrical Men who design, install and maintain America's electrical systems pay to read . . .

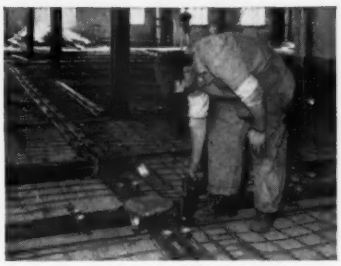
ELECTRICAL CONSTRUCTION AND MAINTENANCE

ABC ABP

A McGRAW-HILL PUBLICATION 330 West 42nd Street, New York 36, N. Y.

ELECTRICAL CONSTRUCTION AND MAINTENANCE delivers 44,269 Electrical Men of whom 4,079 are primarily concerned with design, but who must also be completely familiar with techniques of installation and maintenance.

1962 Theme Issues:
Systems Design; July —



Installation

While not called upon to install systems, the consultant must be familiar with installation practice and problems. The best designed system is useless if it is not practical to install economically. Additionally, he often has the responsibility to assure compliance with his own specifications.

To do his installation job properly, the contractor and his men must be closely familiar with and take advantage of the time-saving, cost-cutting features of the products they must use. Equipment purchases often are influenced by their knowledge of product reliability and ease of installation.

To operate and maintain an electrical system, the plant electrical man must have a working knowledge of installation detail to minimize his company's costs and his own maintenance troubles. In his role as installer, the plant electrical man must understand the application of products in helping him solve his needs.

ELECTRICAL CONSTRUCTION AND MAINTENANCE delivers 44,269 Electrical Men, of whom 23,450 are primarily concerned with installation, but who also require technical data on design and maintenance.

Maintenance

In designing an electrical system, the consultant is always aware that someone else will have to keep it in operation with a minimum of down-time and expense. Such considerations frequently dictate design decisions.

Often, industry calls upon the contractor to maintain a plant's electrical system on a contract basis. In addition, during installation, he must anticipate the maintenance requirements of plant personnel responsible for a system's proper functioning.

The economical and efficient day-to-day operation of his electrical system is this man's responsibility. In addition to performance benefits, product features which contribute to efficient, low-cost electrical service must be sold to him.

ELECTRICAL CONSTRUCTION AND MAINTENANCE delivers 44,269 Electrical Men, of whom 14,648 are primarily concerned with plant system operation and maintenance, but also must be aware of equipment and system design and installation.

Sell the Electrical Man

in the publication he pays to read

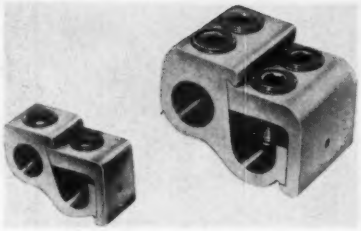
Some magazines concentrate editorial coverage on system design. They ignore the consultant's essential requirements for installation and maintenance information. ELECTRICAL CONSTRUCTION AND MAINTENANCE serves the needs of the Electrical Man—all three parts of him.

Some magazines concentrate editorial coverage on installation practices and problems. They forget that the electrical contractor must be equally familiar with design and maintenance techniques. ELECTRICAL CONSTRUCTION AND MAINTENANCE serves the needs of the Electrical Man—all three parts of him.

Some magazines concentrate editorial coverage on plant maintenance. They consequently gloss over the important needs of the plant electrical man for design and installation information. ELECTRICAL CONSTRUCTION AND MAINTENANCE serves the needs of the Electrical Man—all three parts of him.

Only in Electrical Construction and Maintenance are the needs of the Electrical Man — all three parts of him — concentrated on the central technology he must have to perform his three-sided job. Call your EC&M representative for more information on how to sell the Electrical Man.

January—*Outlook and Review of 1962;* March — *Electric Space Heating;* May — *Modern Electrical Tools and Equipment;* September — *Annual Statistical Issue;* October — *Annual Lighting Issue.*



Tap Connectors (28)

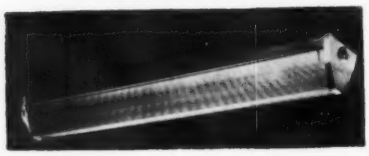
New GTA aluminum tap connectors for copper or aluminum conductors. Connections are made individually to main and tap. They may be used to replace any conventional tap connector such as split bolts, two-bolt clamps and parallel connectors. Main and tap conductors lay parallel in trough or junction boxes. They are available in 11 sizes for wire range of 750 MCM 60 No. 14 AWG. They are UL listed for use with either copper or aluminum conductors in any combination.

Ilsco Corporation, 4730 Madison Road, Cincinnati 27, Ohio

Light Source (29)

New Type LS-3 long-range light source permits the photocell to be as much as 50 ft from the light source. The light source is a complete unit including a low-voltage lamp and a step-down transformer for connection to any 115-volt ac circuit. The assembly is contained in a cast-aluminum housing, sealed against moisture and dirt. Mounting bracket permits light beam to be aimed in any direction, horizontally and vertically, and can be locked in place to maintain alignment of the beam. Unit is 6-$\frac{7}{8}$ by 5-$\frac{1}{4}$ by 3-$\frac{1}{8}$ in. including mounting bracket.

Farmer Electric Products Co., Inc., 2300 Washington St., Newton Lower Falls, Mass.



Luminaire (30)

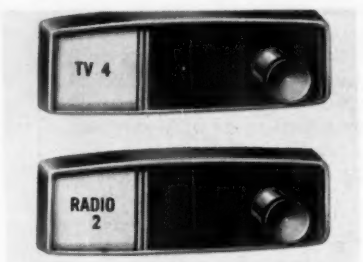
New vaportight all-weather fluorescent luminaire series. Assembly of non-corrosive extruded aluminum with heavy-duty prismatic acrylic diffuser is completely gasketed. Available in 4-, 6- and 8-ft lengths for use with one or two Slimline, rapid-start or high-output fluorescent lamps. Integral clevis arrangement will permit installation by means of suitable brackets for pendant, surface, 45° corner or wall mounting. Fixtures can be coupled for continuous installation.

McPhilben Manufacturing Co., Inc., 1329 Willoughby Ave., Brooklyn 37, N. Y.

Instrument (31)

A new, miniaturized precision recording instrument, called Amprobe Recorder, will make legible, permanent records on a moving paper tape (2$\frac{1}{2}$ in. by 35 ft) of any variable—voltage, current, power, temperature, pressure, etc.—that can be converted to an equivalent electrical signal. The recorder is 3$\frac{7}{16}$ in. by 5$\frac{3}{8}$ in. by 1$\frac{11}{16}$ in. It can be used as either a portable monitoring-and-recording device, or with a panel-mounting adapter, as a built-in component of an instrument system. Two basic types of meter movements are available to measure a wide range of dc and ac electrical quantities without amplification.

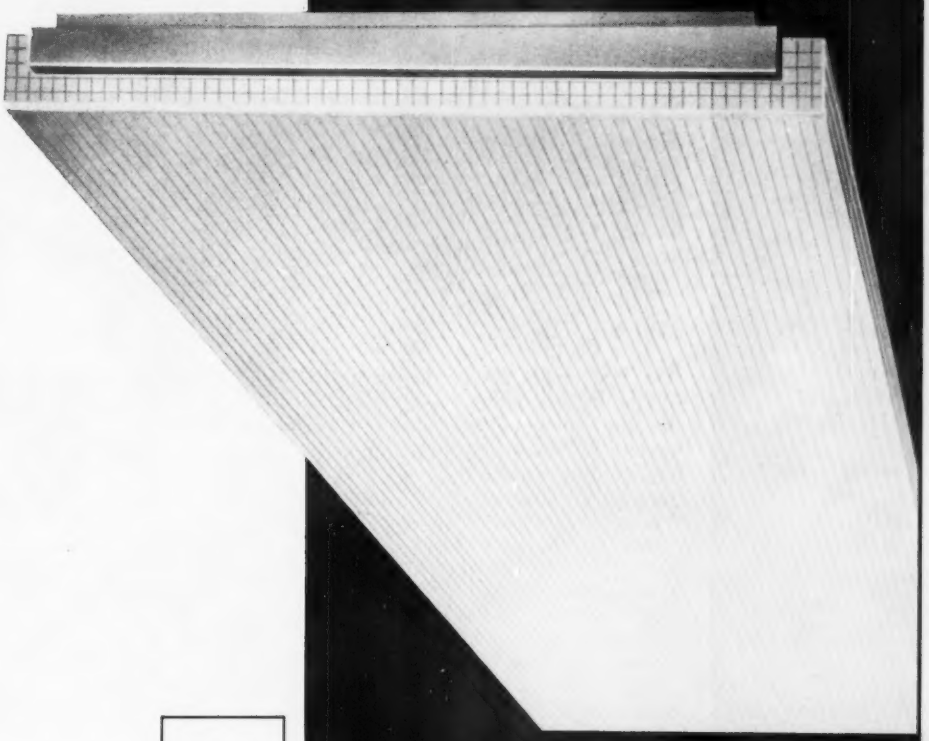
Amprobe Instrument Corp., 630 Merrick Road, Lynbrook, N. Y.



Radio TV-Intercom Unit (32)

A new concept in hotel-motel television has been introduced. Called the Host 9030, the 19-in. TV receiver picks up radio signals over unused TV channels and can combine TV, radio, background music and personnel-call systems all in the same unit. The receiver has an illuminated channel view window and distinctive color indicating which system the set is tuned for. When it is turned on for TV, the viewer will instantly see the green letters "TV" and a channel number against an opaque background in the channel window. Picture tube is instantly shut off when set is turned from TV to radio. Should the selector dial be turned back to TV position from any other point, the TV picture will return instantly.

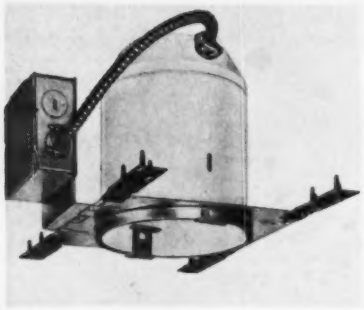
TV-Communications Dept., Westinghouse Electric Corp., 353 Park Avenue South, New York, N. Y.



Domino luminaires — new beauty and versatility in lighting. Totally lens-enclosed, with an apparent depth of only 1½". Installs easily as a unit or in rows, for a free-flowing unbroken line of shadowless, non-glaring light. Easy to relamp. In acrylic or styrene, 2 or 4 Rapid-Start lamps. See your Smithcraft representative, or write for details: SMITHCRAFT CORPORATION • CHELSEA 50, MASSACHUSETTS

Smithcraft

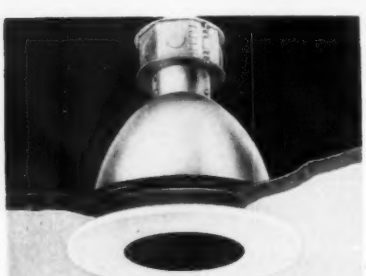
DOMINO!



Recessed Lighting (33)

The "Adjust-All" round recessed housing unit is designed to fit a variety of trims and glass. Available in either a prewired or unwired version, the unit offers 18 different lighting effects without structural or wiring changes. Adjustable for 75-, 100- and 150-watt bulbs and supplied with snap-on bar hangers. Trims and glass accessories are available in open trim reflector lamps; and standard lamps. Prewired round recessed housing measures 8¼ in. high, 6¾ in. in diameter. Plaster frame opening diameter is 7⅛ in. Over-all size is 9 in. by 12¼ in. Unwired housing size is 8¼ in. high, 6¾ in. in diameter. Plaster frame opening diameter is 7⅛ in. Over-all size is 9 by 9¾ in.

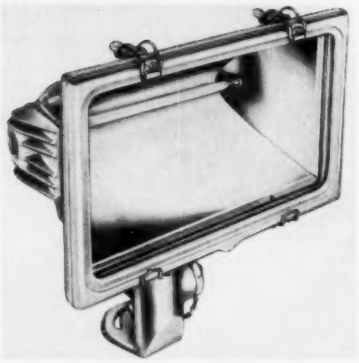
Moe Light Division, Thomas Industries Inc., 207 E. Broadway, Louisville 2, Ky.



Lighting Fixture (34)

A new recessed fixture line, No. 5267 Series of Ellipsoidal down lights, is ideal for use in new construction and remodeling of commercial and residential buildings. Reflector is furnished in either standard Alzak finish or gold, black and pink finish. Units are designed to produce wide-angle distribution and still maintain sharp visual cutoff at 45°. The series includes models to accommodate 100-watt, A-19 and A-21 lamps; 150-watt A-23 lamps; 150/200-watt PS-25 and 200/300-watt PS-20 lamps.

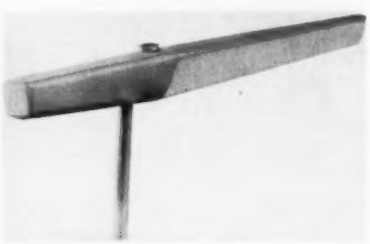
Markstone Manufacturing Co., 1531 N. Kingsbury, Chicago 22, Ill.



Floodlight (35)

A new "Quartzlite 1500" floodlight is similar to the "Quartzlite 500" but makes use of the new 1500-watt Quartz-Iodine lamp. It gives a full 22 lumens per watt throughout a 2000-hour life. Reflector design provides wide horizontal distribution with sharp vertical cut-off to eliminate excessive spill light. The "Quartzlite 1500" is 14⅜ by 9 by 6¾ in. deep and weighs 19 lbs, including a pole fitter. Bulletin No. QL 15-161 is available.

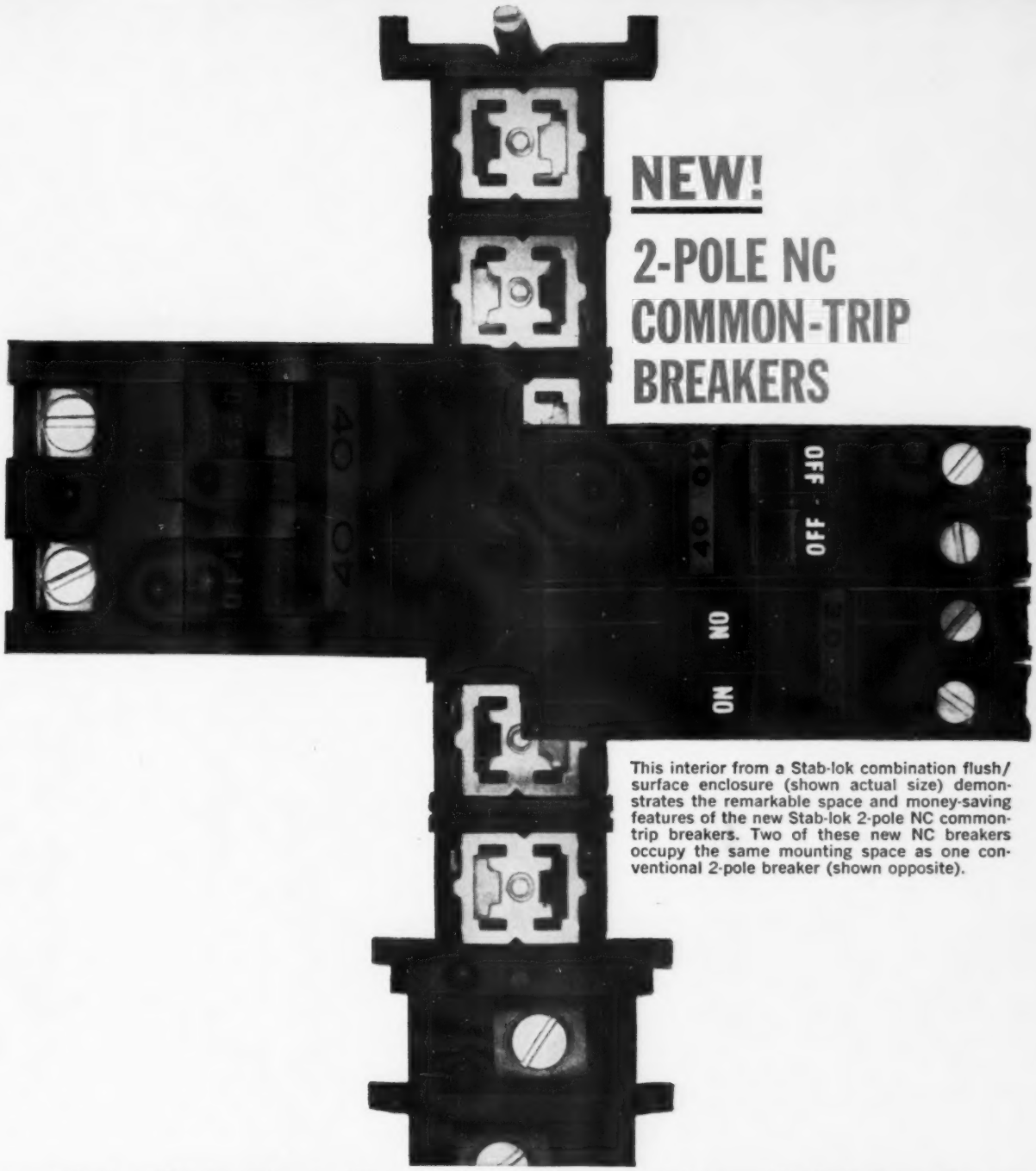
Appleton Electric Company, 1701-1759 Wellington Ave., Chicago 13, Ill.



Fluorescent Luminaire (36)

A fluorescent post-mounted luminaire has been announced. The PMF-104, as it is called, utilizes a single 4-ft fluorescent Power Groove lamp, which produces 6,900 lumens of light from 150 watts of power. The luminaire is designed to be mounted from 10 to 20 ft above the ground. Unit is available with integral bracket for wood-pole mounting for street lighting of residential and rural areas. Provision for individual photoelectric control is available as an optional feature on 120-, 208-, or 240-volt units. The luminaires also can be made available at 277 or 480 volts. Suitable poles are available for 10- to 20-ft mounting heights, steel or aluminum, with conventional anchor base or to be directly imbedded.

General Electric Co., Schenectady 5, N. Y.



NEW!

2-POLE NC COMMON-TRIP BREAKERS

This interior from a Stab-lok combination flush/surface enclosure (shown actual size) demonstrates the remarkable space and money-saving features of the new Stab-lok 2-pole NC common-trip breakers. Two of these new NC breakers occupy the same mounting space as one conventional 2-pole breaker (shown opposite).

now! twice the number of 2-pole circuit breakers in any Stab-lok enclosure!

Here's real economy! With the revolutionary, new 2-pole NC breaker, you can install twice the number of 2-pole circuit breakers than you ever could before!

This newest addition to the famous Stab-lok® system* is a true common trip breaker. An internal common trip bar disconnects both poles when either pole experiences an overload or short circuit! What's more, it is impossible to install the 2-pole NC breaker improperly—it stabs into opposite phases automatically!

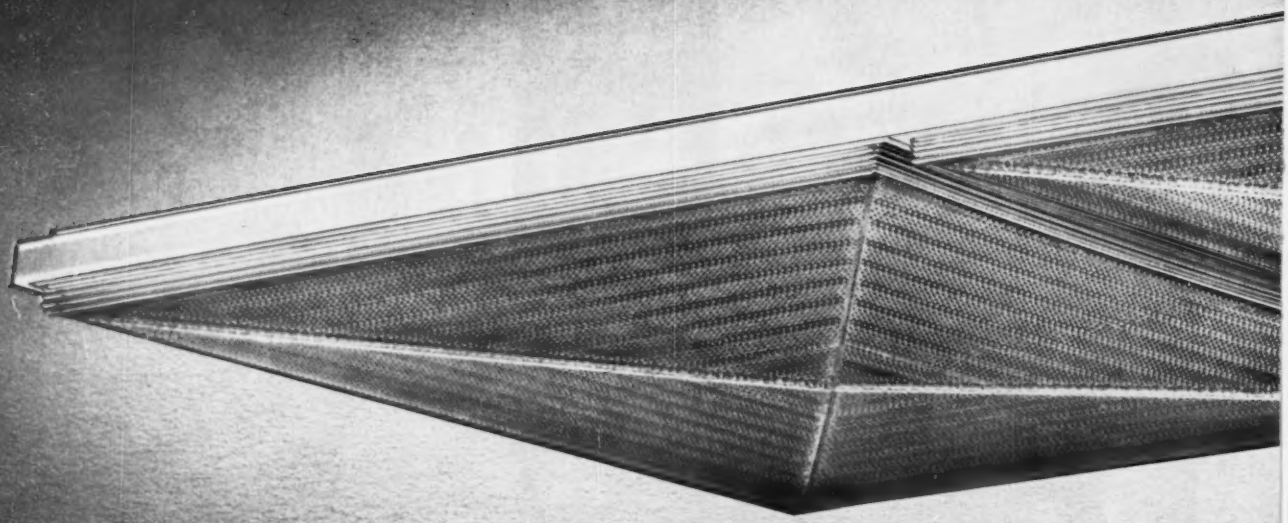
Designed to set the pace for the industry for years to come, the new 2-pole NC breaker has engineering features worthy of Stab-lok: ambient compensation, automatic reset, box lugs and time-proven 4-way compression stabs.

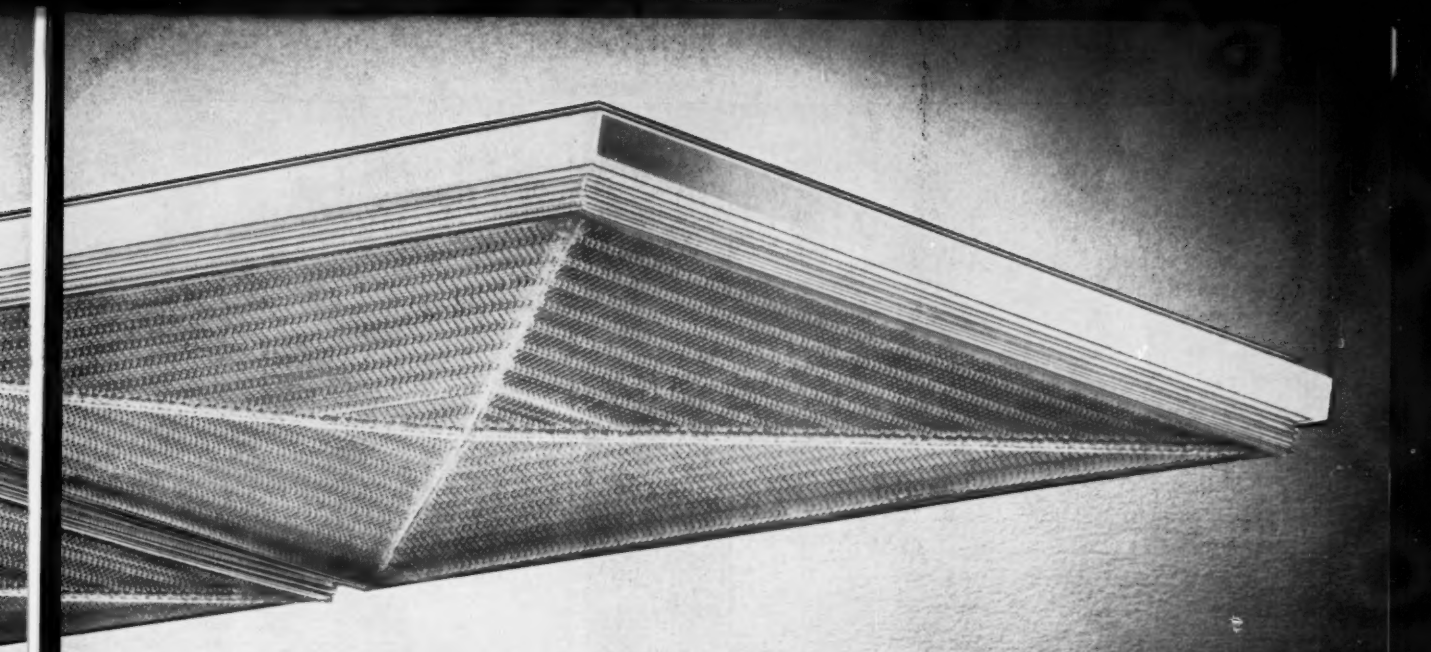
The new Stab-lok 2-pole NC breaker—available now in 15, 20, 30 and 40-ampere ratings—is the latest reason why Federal Pacific, with more than 75 million Stab-lok breakers installed, is first in modular circuit protection!

FPE **FEDERAL PACIFIC ELECTRIC COMPANY**

50 PARIS STREET • NEWARK 1, NEW JERSEY

*The Stab-lok System: The industry's only full-sized half-inch breakers. You get complete inventory flexibility at ⅓ the cost! Why strap yourself with "married couples"? / Stab-lok combination flush-surface enclosures. You get 2 enclosures in 1! Use the exclusive picture frame or throw it away . . . at no extra cost! / All Stab-lok enclosures—box, interior and trim—come complete in one package. One item to purchase . . . one item to stock! / Engineered to be trouble-free. Proved by 11 years of industry leadership!





A TRIUMPH OF LIGHTING FIXTURE DESIGN FROM DAY-BRITE

Introducing

TIARA

. . . the new measure of lighting quality for offices, stores and schools

Just 3 3/16" slim! New Day-Brite TIARA provides a clean, modern look never before possible with a surface-mounted unit.

A distinctive glow around its wafer-thin frame softens brightness for high visual comfort, and gives the fixture a luminous floating appearance. Pure enchantment for any interior!

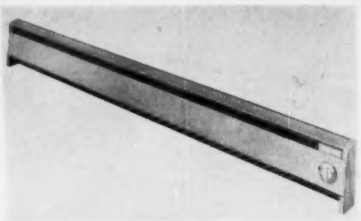
Precision *Pyramid* lenses create additional ceiling interest. There is no noticeable variation in surface brightness . . . no hot spots. Lighting quality is definitely Day-Brite.

For those who want the very finest, it's new Day-Brite TIARA . . . the crowning achievement in lighting fixture design. For complete information, contact your Day-Brite representative or write for free 8-page TIARA booklet. *Day-Brite Lighting, Inc., 6260 N. Broadway, St. Louis 15, Mo., and Santa Clara, Calif. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ont.*

DAY-BRITE

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

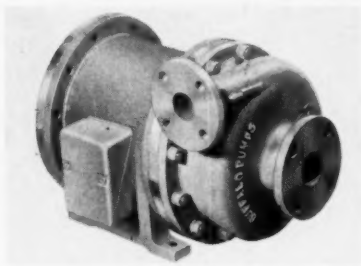
Lens by Holophane Co., Inc.



Electric Baseboard (37)

The "LC" (Linear Control) is available in all Markel Custom-Line baseboard heaters and in the modular baseboard system electric heating equipment. Baseboard conforms to new NEMA standards. "LC" is a built-in automatic linear heat-limiting device located and protecting the entire length of the heating element. When air flow is restricted in any way, immediately and automatically "LC" limits heater to safe normal operating temperature. The "LC" does not permit heater to exceed safe normal operating temperature, even when completely or partially blocked. "LC" is available in complete baseboard units from 3 ft, 750 watts, to 8 ft, 2,000 watts, with or without the Markel built-in thermostatic control.

Markel Electric Products, Inc., Buffalo, N. Y.



Pumps (38)

A new line of centrifugal pumps, totally enclosed and hermetically sealed for use with toxic, inflammable, or highly volatile liquids. Simplified design includes a self-adjusting bearing. Positive protection is provided against leakage of liquids. New line at present will include 13 sizes, with discharges ranging from 1 to 5 in. Standard units are designed for 120 psi and temperatures of 40° F through 250°F. Special models are available for higher pressures and temperatures. In the event of excess loads, automatic thermoprotectors imbedded in stator rotor windings prevent motor burn-out.

Buffalo Pumps Div., Buffalo Forge Co., Buffalo 5, N. Y.

CUT LIGHTING COSTS WITH WESTINGHOUSE LAMPS

The lamps shown above are just three of more than 8000 Westinghouse lamp types designed to give the most efficient lighting. To realize the lowest possible lighting costs, take advantage of the Westinghouse Lighting Cost Reduction Plan. It can help you save in one or more of these ways:

1. **Reduce your cost of lamp purchases**
2. **Reduce your lamp replacement labor costs**
3. **Increase your lighting level for the same or lower power costs**
4. **Give you more efficient use of power**

Your Westinghouse representative will be glad to show you how to apply the Lighting Cost Reduction Plan to your installation. For full information, contact your authorized Westinghouse Lamp Agent, or your Westinghouse Lamp Division Sales Office.

You can be sure . . . if it's **Westinghouse**

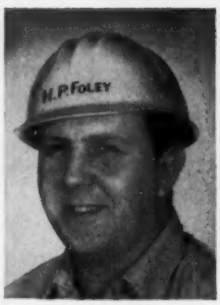
Westinghouse Lamp Division, Westinghouse Electric Corporation, Bloomfield, N.J.

NATIONWIDE–Top

T. E. AUER
L. K. COMSTOCK
MIAMI HERALD NEWS BLDG.
MIAMI, FLORIDA

FRANK BECKER
CUTTER ELECTRIC
A. B. CHANDLER MED. CENTER
LEXINGTON, KENTUCKY

FRED BENT
J. J. LIVINGSTON CO.
MISSILE FACILITIES
BANGOR, MAINE



ROBERT F. BROWN
H. P. FOLEY
ATLANTIC REFINERY EXP.
PHILADELPHIA, PENNSYLVANIA

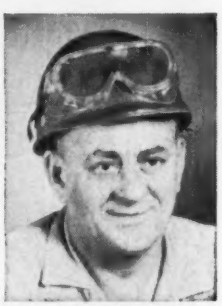
JOE DeGOURSEY
M. B. FOSTER
HARBOR STATION PWR. PLT.
BRIDGEPORT, CONNECTICUT

H. J. (BERT) EVERSON
DAVID W. MURRAY CO.
OXYGEN FACILITY
JONES & LAUGHLIN STEEL CO.
CLEVELAND, OHIO

M. A. (MIKE) GEFFEL
E. C. ERNST, INC.
PITTSBURGH CIVIC AUDITORIUM
PITTSBURGH, PENNSYLVANIA

FRANK KNAUS
WASATCH ELECTRIC CO.
HERCULES POWDER PLANT
BACHUS, UTAH

HELMUT O. KRIPPENDORF
HARLAN ELECTRIC CO.
POST OFFICE
DETROIT, MICHIGAN

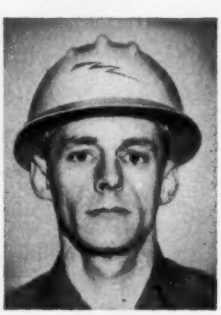


P. D. DUDLEY LA SALLE
SACHSE ELECTRIC CO.
PLANTATION PIPE LINE
BATON ROUGE, LOUISIANA

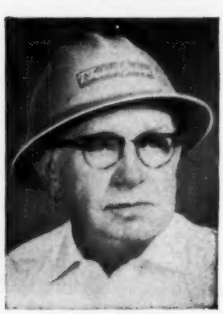
WES LOMAX
DRON ELECTRIC
MARK TWAIN EXPRESSWAY
ST. LOUIS, MISSOURI

BILL LOUDON
FISCHBACH & MOORE
LOS ANGELES INT'L. AIRPORT
LOS ANGELES, CALIFORNIA

JAMES MACNEAL
BLUMENTHAL KAHN ELECT. CO.
CARLINGS BREWERY
BALTIMORE, MARYLAND

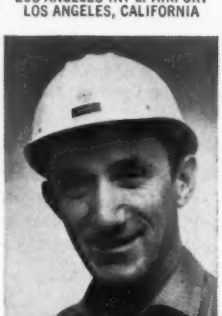


HERB MASON
HORACEK-HAYDEN
BAUSCH & LOMB OPTICAL PLANT
ROCHESTER, NEW YORK



STU McROBERTS
T. F. JACKSON INC.
THROGGS NECK BRIDGE
NEW YORK CITY, NEW YORK

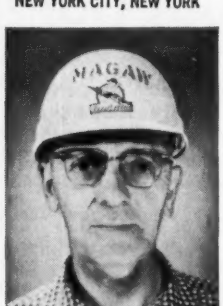
MAURICE PEED
WALTER DOE CO.
SMITHSONIAN INSTITUTE
WASHINGTON, D. C.



HARRY SCHOETTELKOTTE
BERTKE ELECTRIC
NOVAMONT CHEM. PLANT
KENOVA, W. VIRGINIA

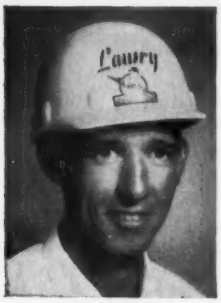
JOE STROYAN
SCOTT BUTTNER ELECTRIC
UNITED TECH. RESEARCH CENTER
COYOTE, CALIFORNIA

DALE TAYLOR
SANBORN-WATSON FLAGG
CITY-COUNTY BLDG.
INDIANAPOLIS, INDIANA



VIC THELEN
MAGAW ELECTRIC CO.
ALLEN-BRADLEY CO.
OFFICE AND RESEARCH BLDG.
MILWAUKEE, WISCONSIN

Field Men say...



W. S. ELLISON
LOWRY ELECTRIC CO.
PAUL BARTOW PWR. PLT., F.P.C.
ST. PETERSBURG, FLORIDA

GEORGE LAWRENCE
TULLAR POWER CONST. CO.
ROCKY REACH DAM
WENATCHEE, WASHINGTON

KEN MURRAY
HATFIELD ELECTRIC
CATERPILLAR TRACTOR PLANT
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"They're OK if they're O.Z."

For over 40 years top Field Superintendents, Engineers, and Project Managers of the nation's leading electrical contracting firms have specified O.Z. electrical fittings.

Their experience and background has taught them to rely on O.Z.'s complete product line and superior quality. They know O.Z.'s broad distributor program means they get the right fittings—at the right time—at the right place.

On your next job—big or small—take a tip from the top. Get the best quality and widest choice at competitive prices. Specify O.Z. fittings all the way and you too will say, **"They're OK if they're O.Z."**

O.Z. ELECTRICAL MANUFACTURING CO., INC.

262 BOND STREET • BROOKLYN 17, N. Y.

Sales Office and Warehouse: 406 So. Cicero Avenue, Chicago 44, Ill. • ESterbrook 9-0326
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- POWER CONNECTORS
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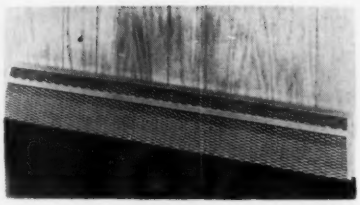
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS



Electric Baseboard (39)

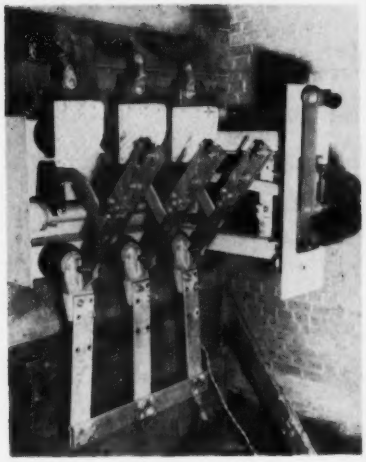
New electric baseboard heaters and accessories which combine high heat density with full protection and low surface temperatures. Heat density is 250 watts per foot at 240 volts and it is available in 3-, 4- and 5-ft lengths. Depth is 2¾ in. and height is 6 in. Accessory items include thermal protectors, thermostat sections, corner sections, appliance outlet sections, all of which may be inter-connected to provide continuous runs and positive grounding. Listed by UL and made to NEMA standards.

Sun-Tron Division, Methode Mfg. Corp., 7435 *W. Wilson Ave., Chicago* 31, *Ill.*

Safety Light (40)

A new safety light, "Mark VI," is designed for use at hazardous locations as well as with emergency warnings systems. It is rated for continuous duty to minus 20°F. The light has a rotating beam that circles 360° achieving a full 45° vertical coverage. This revolving light flashes 60 beams a minute. Inside plants, install at low overhangs, danger areas and emergency exits, or wire unit into plant-disaster systems. Use outside at dangerous intersections, high traffic exits, switching yards, construction work, etc. Unit uses 104 watts. Five flash colors available and choice of 110 or 220 volts. Ease of maintenance, simplified standard electrical and mechanical mounting are features.

Tripp-Lite, 133 *N. Jefferson St., Chicago* 6, *Ill.*



Switch **(41)**

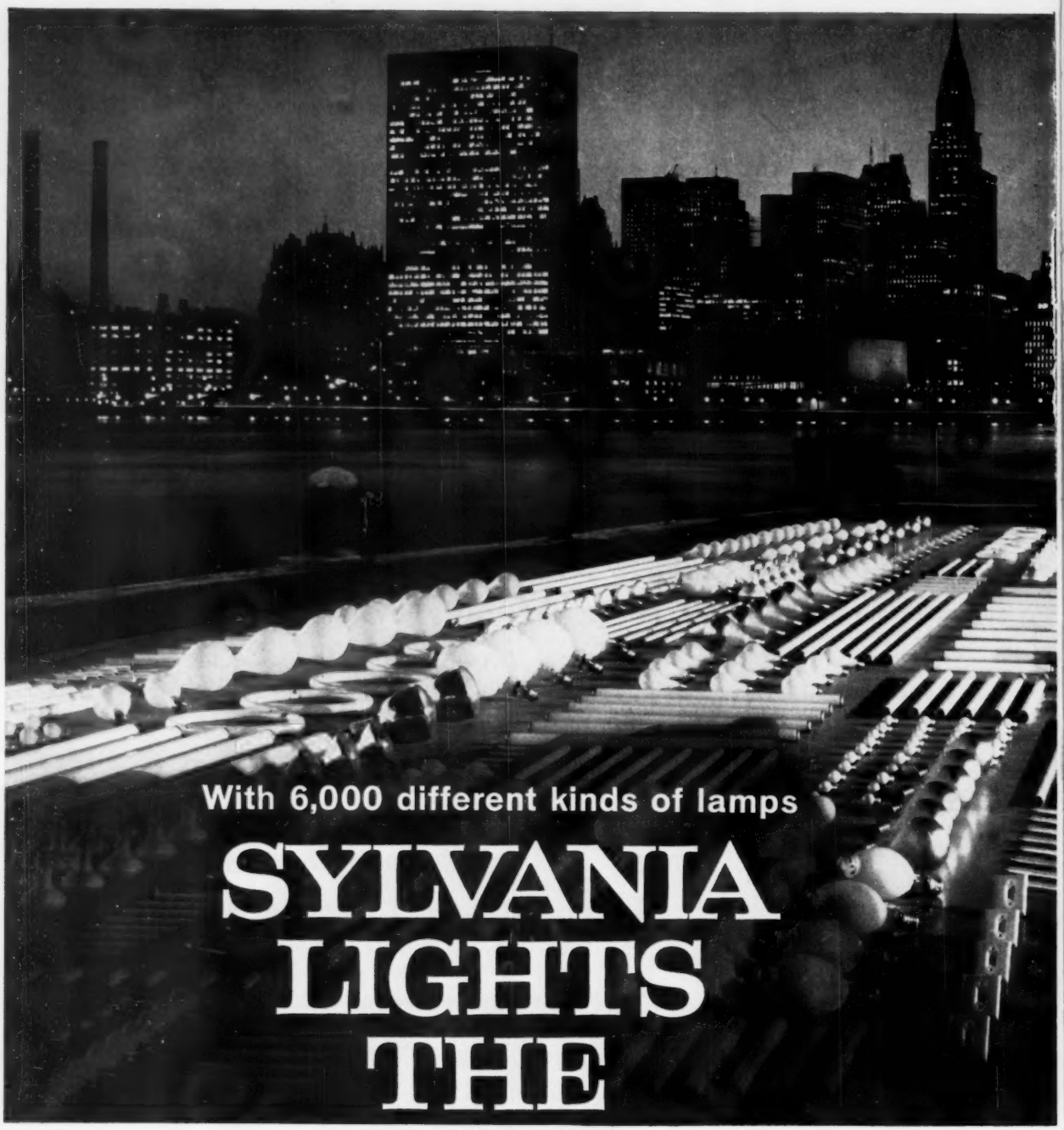
A new type of load-break switch (LBF-2) for fault closing in ratings 5, 7.2 and 14.4 kv is available. At 5 and 14.4 kv, the fault closing ability is 60,000 and 40,000 amps, respectively. The LBF-2 opens 600 or 1200 amps load current at 80% power factor and handles transformer magnetizing current in addition to small capacitive currents. The interrupter is a unitized assembly of pole units, mounting frame, spring operating mechanism, and operating handle. Unitized assembly may be mounted in its own enclosure or incorporated in a metalclad switchgear by installing four bolts in mounting frame. Literature is available.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

Tool **(42)**

A new drilling tool for masonry and glazed tile, called Impacto, fits all popular makes of industrial and heavy-duty $\frac{1}{4}$-in., $\frac{7}{16}$-in., $\frac{3}{8}$-in. electric drills. Unit assembles to the threaded hub of the electric drill. The use of carbide guide studs to engage the race in the enclosed cam, to attain this impact action, permits guide studs to be withdrawn and used as a conventional drill without disassembling the Impacto unit. Weight is 1 lb. Aluminum and steel casings are used. Literature is available.

Impact Rotor Tool, Inc., Irwin, Pa.



From a world leader in light, a steady stream of new and better ways to light your home, your business and your world

At Sylvania we're in friendly competition with the sun. For more than 59 years we've made it our business to push back the darkness and bring in the light.

Today, we make more than 6,000 different kinds of lamps to serve the world's growing and almost unlimited needs for light.

Just consider our family of fluorescent lamps, for example. Back in 1938, Sylvania brought fluorescent lighting to the market. In the intervening years we've pioneered more than a dozen major improvements in fluorescent lighting. Recently we introduced a VHO Powertube fluorescent that gives more light than a lighthouse. Our latest is a new "Natural White," the first fluorescent to make colors look real and truly lifelike.

Tomorrow, we'll have *hundreds* of new Sylvania lamps to show you. If you need lamps that are better, brighter, or more economical, see Sylvania. Wherever there is darkness—there is a Sylvania lamp to light the way.

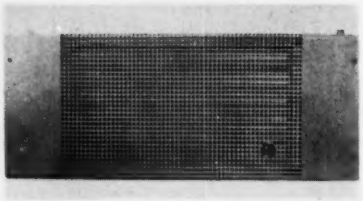
SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Lighting Division, Sylvania Electric Products Inc., Dept. 15, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., Montreal.



Heaters (43)

New natural convection electric heaters for selected area heating in small areas such as home workshop, insulated garages, laundries, basements, utility rooms and small storage areas are now available. In three Btu/hr ratings, heater may be wired for operation with wall-mounted thermostat. Calrod heating elements are breakproof and sagproof. Listed by UL.

General Electric Co., Electric Comfort Heating Section, Appliance Park, Louisville, Ky.

Lighting Fixtures (44)

The fixture, Triad, can be recessed, stem or surface mounted. It is 2¾ in. deep and features a wrap-around low-brightness polystyrene diffuser with prismatic sides that direct a component of light upwards. Designed for the shallower plenum chambers, the recessed depth is 1½ in. The fixture is "modular," designed to even foot lengths. The suspension points for stem and surface mounting are also on even foot centers. Utilizing 48-in. rapid-start lamps, the Triad is made in 2-and 4-lamp combinations, and 4- and 8-ft lengths.

Electro Lighting Corporation, div. of Electro Consolidated Corp., 1535 *Paulina St., Chicago* 8, *Ill.*

Starter (45)

A new static starter for motors, utilizing the Westinghouse-developed silicon-controlled rectifier as the main power switch, has been developed. The "Trinistor" device blocks conduction in the reverse direction. By proper arrangement of the Trinistor units, it is possible to have total control of a 3-phase inductive or resistive load. Standardized starter designs are applicable to 20-hp motors "across-the-line" and up to 75-hp motors with reduced voltage. Firing and switch-

ing circuits are contained in a standard wall-mounted NEMA-1 enclosure. A 220-volt, 3-phase static starter would measure 16 by 14 by 8 in.

Westinghouse Electric Corp., General Purpose Control Dept., Buffalo, N. Y.

Product Briefs

(46) Hykon Manufacturing Co., Alliance, Ohio, has introduced a new **tool,** Porta-Puller, a portable lightweight machine which comes with 200 ft of steel cable guaranteed for 2000 lb strength.

(47) New Cornell-Dubilier "Tiny Time" 50- and 100-kvar pf **capacitors** that cut power capacitor size 25 to 30% are now being produced by Federal Pacific Electric Co., Newark, N. J. . . . (48) Skil Corp., Chicago, Ill., has introduced a new improved **tool,** Model 726 Roto-Hammer for drilling masonry holes.

(49) Advance Transformer Co., Chicago, Ill., has announced an improved "Solid-Fil" fluorescent lamp **ballast** with drip-free unitized construction. . . . (50) Prescolite Mfg. Corp., Berkeley, Calif., has introduced their new series of geometric shapes for incandescent **lighting** called Light-Forms.

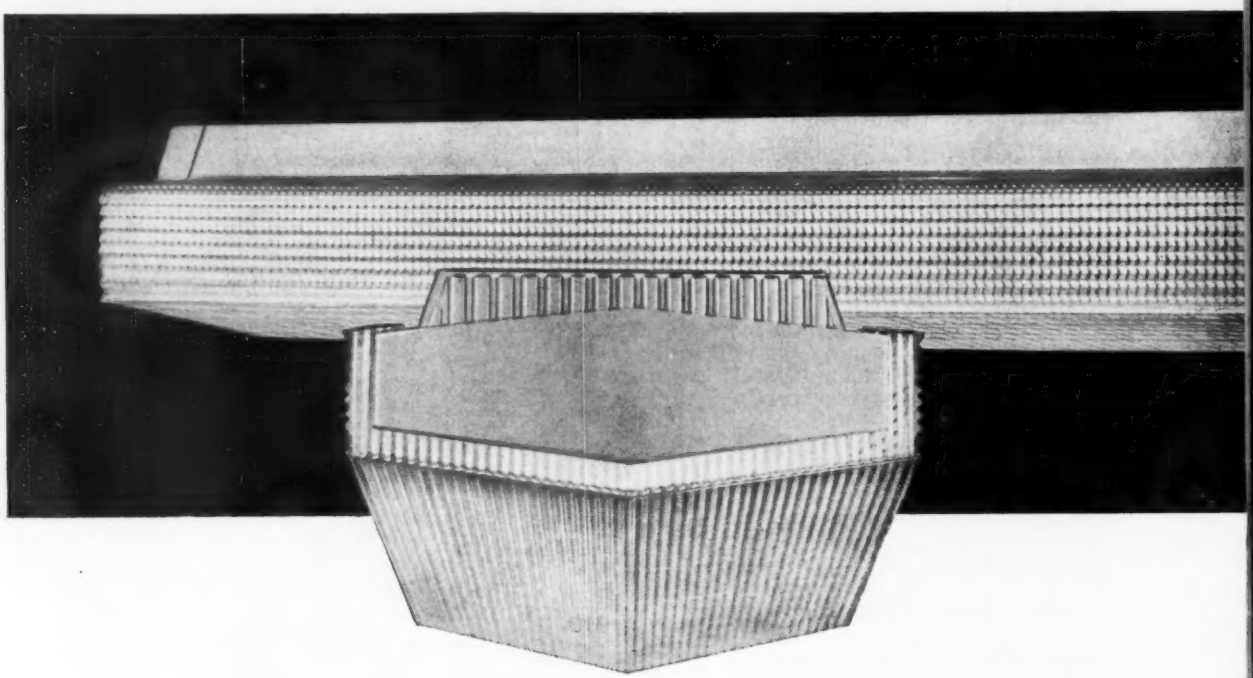
(51) General Electric Co., Cleveland, Ohio, has announced two major improvements—higher light output and smaller size—for 200-watt **light bulbs** used in commercial, industrial and institutional applications. . . . (52) A new line of plastic electrical **conduit,** developed for use underground or encased in cement, has been introduced by Lasco Industries, Montebello, Calif.

(53) Holub Industries, Inc., Sycamore, Ill., has announced their new Hi-225 cable ripper **tool** which slits outer covering of all sizes of braided and plastic (Type NM) non-metallic cables. . . . (54) Non-magnetic, sparkproof stainless-steel **wall plates** safe for hospitals, industrial and residential uses are now being manufactured by Bell Electric Co., Chicago, Ill.

(55) Appleton Electric Co., Chicago, Ill., is now marketing a new outlet protector **cover** and **locator** (code cover) which fits all standard 3 by 2 switch boxes and industry standard outlet box covers.

This is Opticon...a fixture designed to prove that a modest budget need not mean the sacrifice of lighting performance, aesthetic standards, or top quality construction. The lens, for instance, is injection molded in a single, crystal-clear unit 48″ long. Secured by safety hinges, it swings away from either side for fast relamping without the use of tools. Its sides are patterned both inside and out with prisms that run at cross directions. The result is diffused peripheral lighting on ceiling areas for

THIS NEW FIXTURE HAS



LIGHT

Jersey City 5, New Jersey / Showrooms: New York, Chicago, Dallas, Los Angeles

LIGHTOLIER fixtures are stocked by these Authorized Distributors:

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Mayer Elec. Sup. Co.
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F. E. Smith Elec. Co.

ARIZONA
Phoenix:
Brown Wholesale Elec.
Tucson:
Beacon Ltg. Fix. Co.

ARKANSAS
Little Rock:
Adcock Ltg. & Sup.

CALIFORNIA
Bakersfield:
San Joaquin Whlse. Elec. Co.
Fresno:
Electrical Suppliers, Inc.
Los Angeles:
Gough Industries, Inc.
Palm Springs:
Tri-County Elec. Whlsrs.
Riverside:
Tri County Elec. Whlsrs.
Sacramento:
Capital Whlse. Elec. Co.
San Bernardino:
Tri-County Elec. Whlsrs.
San Diego:
Sunlight Elec. Sup. Co.
San Francisco:
California Elec. Sup. Co.

COLORADO
Denver:
Central Elec. Sup. Co.

CONNECTICUT
Bridgeport:
B. M. Tower Co., Inc.
Hartford:
Beacon Light & Sup. Co.
New Haven:
Grand Light & Sup. Co.
New London:
United Elec. Sup. Co.
South Norwalk:
Klaff's Inc.
Stamford:
Marie Co.
Waterbury:
Starbuck Sprague Co.
Suburban Supply Co.

DISTRICT OF COLUMBIA
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Maurice Elec. Sup. Co.
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Farrey's Whlse. Hdwe. Co.

GEORGIA
Atlanta:
Atlanta Ltg. Fix. Co.
Electrical Wholesalers
Noland Co.
Augusta:
Hart Elec. Sup. Co.
Columbus:
P. & W. Elec. Sup. Co.
Macon:
Noland Co.

HAWAII
Honolulu:
Hawaiian Light & Sup. Co.

ILLINOIS
Champaign:
Tepper Elec. Sup. Co.
Chicago:
Efengee Elec. Sup. Co.
Englewood Elec. Sup. Co.
Hario Elec. Sup. Co.
Hyland Elec. Sup. Co.
Metropolitan Elec. Sup.
Steiner Elec. Co.
Wholesale Elec. Sup. Co.
Elgin:
Fox Elec. Sup. Co.
Joliet:
Joliet Elec. Sup.
Rockford:
Englewood Elec. Sup. Co.
Springfield:
Springfield Elec. Sup. Co.

INDIANA
Ft. Wayne:
Mossman-Farnelle Co.
Gary:
Englewood Elec. Sup. Co.
Indianapolis:
Farrell-Argast Elec. Co.
South Bend:
Englewood Elec. Sup. Co.

IOWA
Des Moines:
Weston Lighting, Inc.

KANSAS
Kansas City:
W. T. Foley Elec. Co.
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KENTUCKY
Louisville:
Henry J. Rueff Co.

LOUISIANA
Baton Rouge:
Electrical Wholesalers, Inc.
New Orleans:
Interstate Elec. Co.

MAINE
Bangor:
Standard Elec. Co
Portland:
Holmes Elec. Supply Co.

MARYLAND
Baltimore:
Baltimore Gas Light Co.
Dominion Elec. Sup. Co.
Hagerstown:
Noland Co.
Tristate Elec. Sup. Co.
Salisbury:
Artcraft Elec. Sup. Co.

MASSACHUSETTS
Boston:
Boston Lamp Co.
Mass. Gas & Elec. Light Co.
Henry L. Wolfers, Inc.
Pittsfield:
Carr Supply Co.
Springfield:
M. W. Zimmerman, Inc.
Worcester:
Benjamin Elec. Sup. Co.

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Madison Elec. Co.
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Saginaw:
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Duluth:
Northern Elec. Sup. Co.
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Kansas City:
Glasco Elec. Co.
Rosener Elec. Sup. Co.
St. Louis:
M. K. Clark
Springfield:
Southern Materials Co.

MONTANA
Great Falls:
Glacier State Elec.

NEBRASKA
Lincoln:
White Electric Supply Co.
Omaha:
Electric Fix. & Sup. Co.

NEVADA
Reno:
Western Elec. Dists. Co.

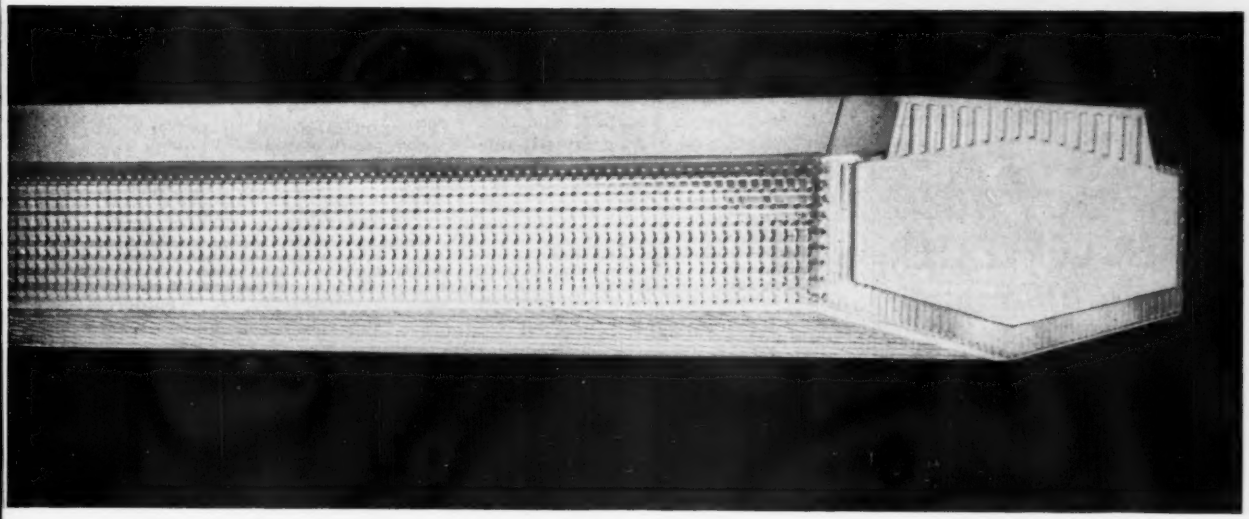
NEW HAMPSHIRE
Portsmouth:
Mass. Gas & Elec. Light Co.

NEW JERSEY
Atlantic City:
Franklin Elec. Sup. Co.
Camden:
National Elec. Sup. Co.

NEW MEXICO
Albuquerque:
The Lighting and Main Co.

low brightness contrast. The bottom throws wide-angle, glare-free task light downward through sharply molded, brightness engineered prisms. Other noteworthy features include: interlocking ends for arrow straight continuous runs (no dark joiner straps required); slim 3¾″ depth; completely enclosed construction to keep fixture cleaner longer; one lamp and two lamp models. Trim, efficient, handsome... its economy will surprise you. Available either stem or surface mounted in 48″ or 96″ lengths.

A MULTI-FEATURE LENS



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Catalogs, Bulletins

(56) INCANDESCENT LUMINAIRES. Brochure covers three 13-in-sq ceiling-recessed incandescent luminaires having prismatic glass reflectors and lenses. Holophane Co., Inc.

(57) ELECTRICAL CONDUIT. Transite conduit Types I and II are described in new brochure TR-247A. Johns-Manville, Pipe Div.

(58) WIRING. 16-page manual explains the use of hollow-core precast concrete floor and roof slabs as raceways for electrical wiring. Flexicore Co., Inc.

(59) PUSHBUTTONS. Bulletin GEA-7127A, 12-page revision, includes new forms added to complete line of industrial miniature oil-tight pushbuttons. General Electric Co.

(60) LIGHTING. 4-page brochure describes industrial lighting equipment which is especially designed to meet illumination needs in critical work areas. Fostoria Corp.

(61) DOWNLIGHTS. A new line of incandescent downlights being made for Westinghouse by Frink Corp. is described in 12-page catalog entitled "Westinghouse-by-Frink Downlight Catalog FR2." Frink Corp.

(62) PILOT LIGHT ASSEMBLIES. Recent developments in Dialco pilot light assemblies are presented in two publications: "Digest of Pilot Lights" (Form L-161C) and "Transistorized Neon Indicator Lights" (Form STI-166A). Dialight Corp.

(63) CAPACITORS. Catalog C-914 on capacitors for ac applications describes motor-starting electrolytics as well as Clorinol-impregnated motor-run capacitors. Sprague Products Co.

(64) CONTROLLED SPEEDS. Bulletin F-1952, revised, incorporates the advances made in central control instrumentation and panel design, and in signal transmission methods within process-controlled automatic systems. U. S. Electrical Motors Inc.

(65) CIRCUIT BREAKERS and safety switches are described in 32-page guide, including costs, sizes and installation. Westinghouse Electric Corp., Standard Control Div.

(66) FIRE ALARM SYSTEMS. New series of system data sheets describe eight fire alarm systems available. S. H. Couch Co., Inc.

(67) FLOODLIGHTING. Promotion kit contains booklet on how to promote floodlighting, architectural floodlighting data reprinted from IES Lighting Handbook, and floodlighting public, civic and industrial buildings, monuments and churches. Floodlighting Institute.

(68) PRECISION SWITCHES. 4-page Form 84-449 entitled "Micro Switch Precision Switches for High Temperature Locations" describes several switch types which provide dependable precision snap-action switching in both high and low temperature extremes. Micro Switch.

(69) DISTRIBUTION SYSTEM. A safety-engineered distribution system to supply power to electrical resistance strip heaters for preheat and stress relief in welding is described in data sheet. J. B. Nottingham & Co., Inc.

(70) CONTACT BLOCK. Bulletin GEA-7320 describes new CR2940 single-circuit shallow contact blocks for use with heavy-duty oil-tight pushbutton operators. General Electric Co.

(71) BUSWAY. 8-bulletins cover 400-cycle bus, plug-in troffers and low-impedance feeder and plug-in bus. Electric Distribution Products, Inc.

(72) POWER CAPACITORS. GEA-7198, 4 pages, gives information on features, application, ratings and dimensions of new low-voltage power capacitors which can be used on virtually all industrial power distribution systems. General Electric Co.

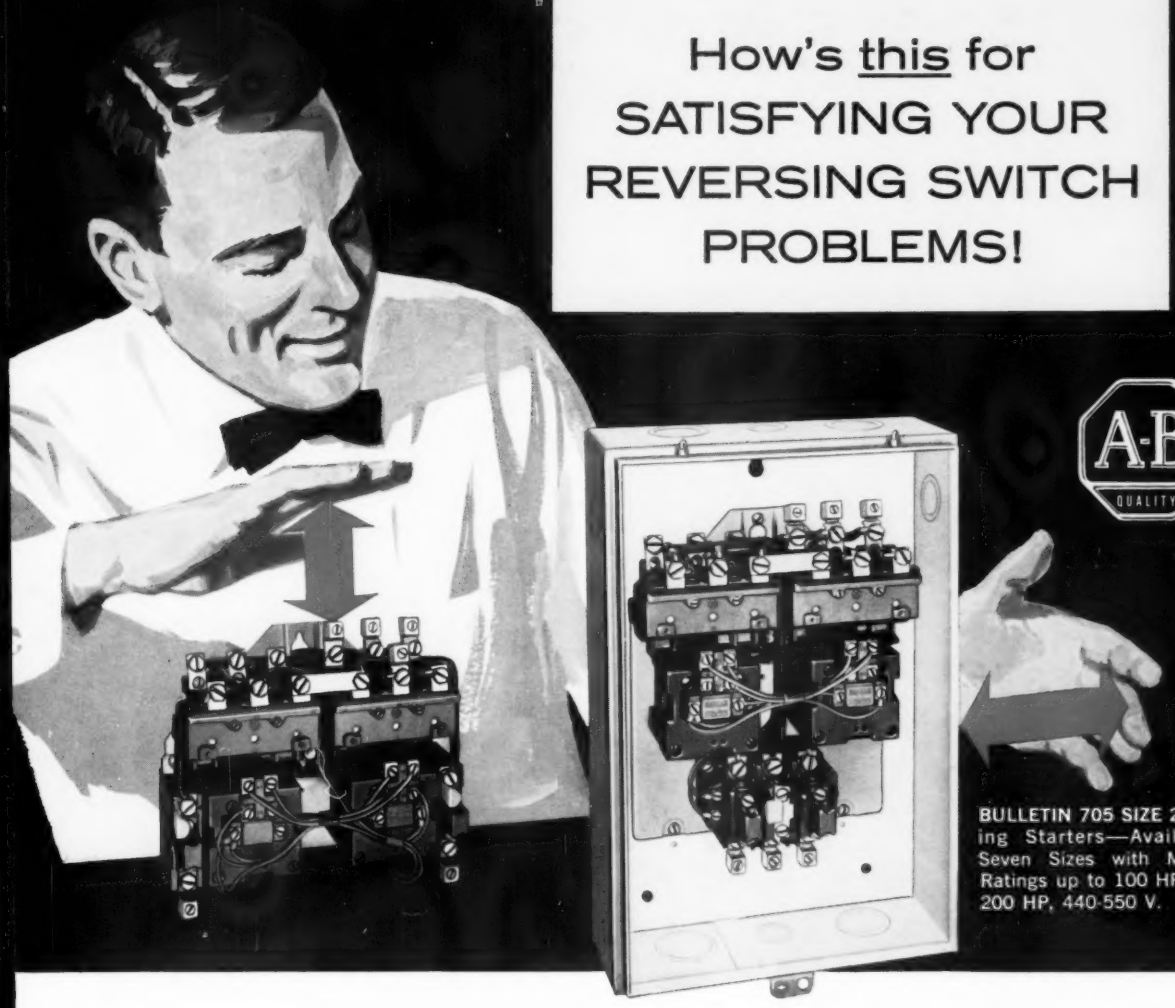
(73) LIGHTING. Brochure 1856 on decorative drum lighting fixtures introduces their new series of flare-shaped drums. Thomas Industries Inc., Moe Light Div.

(74) DISCONNECTING SWITCHES. 20-page Bulletin 36-250 covers hookstick and group operated, 7.2- to 345-kv outdoor disconnecting switches. Westinghouse Electric Corp.

(75) WOUND-ROTOR MOTORS ranging in size from 1 to 30 hp are described in Bulletin 104. Louis Allis Co.

(76) TIME METERS. GEZ-3354, 4 pages, describes latest addition to line of "Big Look" panel instruments—the Type 236 elapsed time meter. General Electric Co.

How's this for SATISFYING YOUR REVERSING SWITCH PROBLEMS!



BULLETIN 705 SIZE 2 Reversing Starters—Available in Seven Sizes with Maximum Ratings up to 100 HP, 220 V; 200 HP, 440-550 V.

Open or Enclosed—THEY SAVE SPACE WHERE IT COUNTS MOST

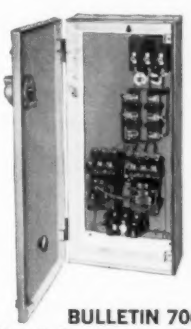
Listen to this—*all new "open type" A-B reversing switches* have the overload relays mounted at the sides as shown—ideal construction for panel channel wiring. It fits with A-B contactors and starters of the same rating. The over-all width for each rating is also appreciably less than it was with the old Bulletin 705.

All new enclosed A-B reversing switches have the overload relays (either 2 or 3) mounted as a "block" below the reversing switch. This permits a narrow enclosure—ideal for most mountings on machine tools.

Rating for rating, the new Allen-Bradley reversing starters will set new records for long, trouble-free life. The new structure is so simple and so sturdy that nothing can go wrong. If you have a particularly tough service application, try the new A-B Series K reversing switches—and live happily ever after.

You'll like the new line of modern, attractive enclosures, too. Brooks Stevens, internationally known industrial designer, has given them that extra "eye appeal"—which is an asset for every installation.

For complete information on these new reversing switches, please write today for Publication 6100, Allen-Bradley Co., 1316 S. Second Street, Milwaukee 4, Wisconsin.



BULLETIN 706 Size 1 Combination Reversing Starter—available with fused or unfused manual disconnect switch, or as Bulletin 707 with circuit breaker.

17-61-MR

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QUALITY MOTOR CONTROL

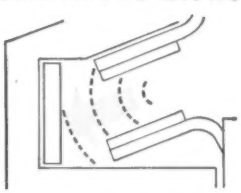
The Superior "Quality" of the New Allen-Bradley Starters GREW OUT OF DESTRUCTIVE TESTS

Tests which subject starters to far more severe conditions than heavy-duty service are "routine" at Allen-Bradley and provide data for improved starter design

There was no question about the "quality" of the old Bulletin 709 starters but—the new line is far superior. With their built-in "extra" interrupting capacity, each rating of the revolutionary new Allen-Bradley motor starters can operate with ease at maximum rated capacity for prolonged periods—and still have more than ample reserve for emergency conditions. The new, totally enclosed arc hoods are hot molded of a material having unusual arc quenching properties. In addition, powerful arc blowouts and wrap-around metal quenchers assure fast, efficient arc extinction and heat dissipation. There are many other features about this new line that you ought to know. Therefore, please write for Bulletin 6100, today! Allen-Bradley Co., 1316 South Second Street, Milwaukee 4, Wisconsin.

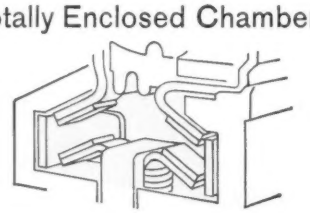
Here's How EXTRA Interrupting Capacity Is Built Into All Allen-Bradley Starters

Powerful Arc Blowout



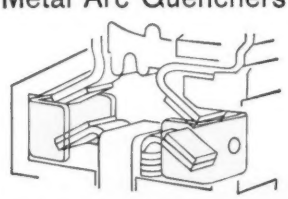
The powerful magnetic field, generated between the contacts when an arc is drawn, forces the arc off the end of the contacts. It is quickly cooled and extinguished by the large surfaces of the hood.

Totally Enclosed Chambers



A new, unusually strong and stable material is hot molded to extremely close tolerances. Each chamber of the arc hood is totally enclosed. Thus, the usual effects of ionization and heat are greatly minimized.

Metal Arc Quenchers



Size 2 starters and the higher ratings have metal quenchers in both the front and back of each arc chamber. This efficient construction gives the arc no chance to become destructive.

17-61-MR

ALLEN-BRADLEY

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QUALITY
MOTOR CONTROL

(77) ARMORED CABLE. A complete listing of fittings and accessories for interlocked armored cable is contained in new 4-page Bulletin F11-135. Thomas & Betts Co.

(78) INDUSTRIAL LUBRICANTS booklet describes 6-step program to streamline your lubrication program and cut lubricating costs. Pure Oil Co.

(79) FLOODLIGHTS. Bulletin SF-960 contains specifications, photometric data and installation accessories on the new "Sportoflood" floodlight. Appleton Electric Co.

(80) RESIDENTIAL LIGHTING. 12-page "Econda" catalog features 52 decorative incandescent units designed for economical multi-purpose residential use. Globe Lighting Products, Inc.

(81) LOADCENTERS. Selection and application information on new-design 100-amp single main disconnect panels for fusible loadcenters and new price lists for complete line of fusible equipment are features of 1961 Speedfax Catalog WS-100. I-T-E Circuit Breaker Co., Walker Div.

(82) CABLE SUPPORT SYSTEMS are described in 52-page Booklet 106. Chalfant Products Co., Inc.

(83) PRESSURE-SENSITIVE TAPES. 4-page Booklet DB-56A describes the types of tapes available, how they are constructed, and the factors involved in choosing types. Johns-Manville, Dutch Brand Div.

(84) METAL FRAMING. Bulletin 222 describes application in supporting electrical equipment. Unistrut Products Co.

(85) FOOD-WARMING FIXTURES. Catalog C/1-C describes line of "Infra-Hot" food-warming fixtures, 3¼ in. deep, which may be self-suspended over the food serving operation or built-in. Apextro Products Co.

(86) SOLENOID VALVE. Form V5130 describes new 2-way high-pressure soleniod valve available with either general purpose, watertight or explosion-proof solenoid enclosures. Automatic Switch Co.

(87) LIGHTING. 2nd edition of plastic lighting catalog includes the new K-4 and K-5 series of K-Lite white opal Polystyrene and acrylic prismatic lens panel. K-S-H Plastics, Inc.

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Unbalanced Voltage-to-Ground Readings

QUESTION A40—I have a problem which has everyone in our shop stumped. At one of our industrial accounts, which has a 240-volt, 3-phase, 3-wire, 1600-amp service, we get unusual voltage readings from phase to ground. These are A to ground 270 volts, B to ground 150 volts, C to ground 115 volts. We put two 100-watt lamps in series across phase A and ground, and we get an arc but no light, and the voltage meter drops from 270 volts to 0. We have checked our meter.

I have heard a theory that this is a phantom voltage, but I cannot understand the increase over the service voltage of 240 volts.—T.R.M.

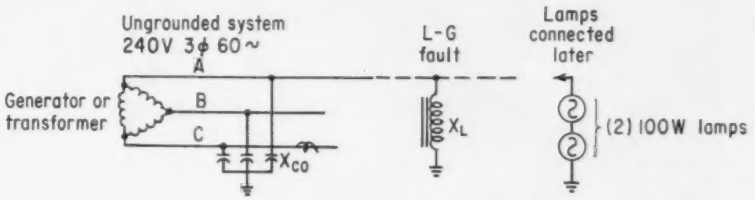

Fig. 1

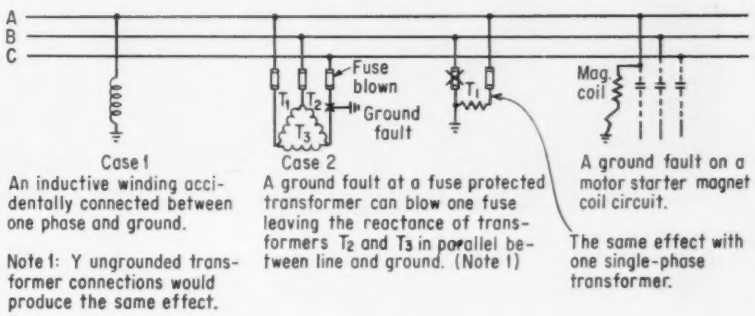

Fig. 2

ANSWER TO A40—Reader T.R.M. seeks an explanation to his observed unbalanced line-to-ground voltage pattern in which one line-to-ground potential is in excess of the line-to-line voltage. The measured unbalanced voltages establish the vector voltage pattern to be that shown in Fig. 4A in contrast with the normal pattern shown in Fig. 4B.

The observed voltage pattern strongly suggests the presence of an inductive-reactance fault connection from phase "A" to ground on the otherwise ungrounded system as indicated on Fig. 1. The explanation for the excess line-to-ground voltage stems from the fact that the ungrounded system is actually unavoidably capacitively grounded through the power conductor insulation. Essentially equal values of capacitive reactance (X_{co}) will exist between each phase and ground under balanced operation as indicated in Fig. 1.

In Fig. 3 are shown the magnitudes of line-to-ground voltages created on the faulted phase by a single line-to-ground fault of resistance, inductive reactance, or capacitive reactance, and the mathematical expressions which control them. (For a detailed explanation of the circuit behavior, see "Industrial Power Systems Handbook"—a McGraw-Hill Book—Chapter 5.) An inductive-reactance ground-fault (caused perhaps by a grounded motor-starter magnet coil or a grounded transformer winding—see Fig. 2) can create elevated line-to-ground potentials of many times normal. In this instance the observed value of 270 volts is about two times the normal value of 139 volts. To obtain a voltage elevation of two times normal (see Fig. 3) requires that the ohmic value of X_L be twice that of the total capacitive reactance to ground $X_{co}/3$; or $X_L = 2/3\ X_{co}$. (Note that twice normal voltage on the "A" phase could also be produced with an X_L lower than $X_{co}/3$. In this case, however, ground potential would lie beyond the "A" phase in the opposite direction such that the line-to-ground voltages on the "B" and "C" phases would be greater than on the "A" phase.)

The value of X_{co} will vary as the amount of connected electric apparatus, such as motors, changes. A likely value of X_{co} on a 500-kva 240-volt 3-phase 60-cycle operating system is a few thousand ohms. For analysis purposes assume that $X_{co} = 2000$ ohms. The corresponding value of X_L necessary to produce twice normal voltage is then, $X_L = 2\ X_{co}/3 = 2(2000)/3 = 1330$ ohms.

The next step calls for examination of the conditions created by the connection of two 100-watt lamps (in series) between the "A" phase and ground. Two cold-filament 100-watt lamps in series represent a resistance of about 30 ohms. Connection of the lamps from phase "A" to ground places them in parallel with the fault reactance X_L (see Fig. 1). The 30-ohm lamp circuit, being of so much lower impedance than the 1300-ohm inductive reactance, creates the effect of grounding the "A" phase conductor through a 30-ohm re-

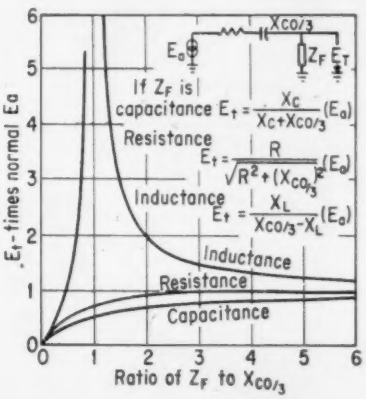

Fig. 3

DUST TIGHT

Approved light fixtures for use in Class 2, Groups E, F, G hazardous locations. Vertical design keeps dust from accumulating, close fitting parts keep it from entering fixture. Coolest burning dust-tight lights mean added safety. 100 and 150-300 watt sizes.

VAPOR TIGHT

The Killark line has vapor-tight light fixtures for every outdoor or indoor need. Design simplicity and interchangeable parts make these lights easy to install and service. Positively weather-proof. Pendent, ceiling, bracket mountings 60 to 500 watt.

FIXTURE HANGERS

Rubber-cushioned, vapor-tight fixture aligners for pendent fixtures. Flexible, shock - absorbing, easy to install.

Explosion-proof fixture hangers for pendent fixtures, Class I, Groups C and D, Class II, Groups E, F, and G.

6132

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"Les Sparks"

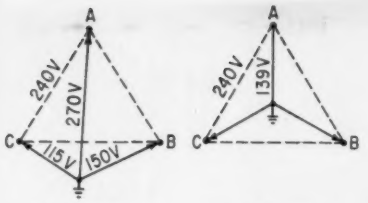
A complete line of industrial and commercial lighting fixtures allows Killark to serve all types of installations with proper protected lighting. The Killark ability to supply exact needs means maximum safety, convenience, and efficiency—for both hazardous and non-hazardous locations.

All Killark fixtures are cast from aluminum to provide important extra advantages. Installed inside or outdoors, they remain permanently rust-proof. They give outstanding service in many areas where corrosion is a problem. Aluminum also dissipates heat at a much faster rate, and is safer because it's non-sparking.

Simplicity of design is still another reason for the superior performance of Killark light fixtures. Most styles have interchangeable parts to allow quick, inexpensive changes in mounting method, wattage capacity, type of globe, or reflector. Relamping can be done easily without tools.

Your Killark dealer can supply these fine light fixtures promptly—from his stock or one of the nineteen Killark warehouses in the United States and Canada.

Killark light fixtures are U.L. and C.S.A. approved.



(A) As observed (B) Normal

Fig. 4

sistor. Fig. 3 again presents the answer to the resulting line-to-ground voltage magnitude. For $R_r/X_{co}/3 = 30/670 = 0.045$, the resulting "A" phase voltage to ground, $E_t = 0.045$ normal $= 0.045$ (139) $= 6.25$ volts. Thus, in reality the connection of the lamps causes the voltage to drop to a very much lower value but not actually to zero.

These overvoltages, which can be developed in ungrounded electric systems, appear across the apparatus insulation and can lead to premature insulation failure. Reader T.R.M. might look into the possibility of neutral grounding of his system to avoid a repetition of this or other similar varieties of line-to-ground overvoltages.—R.H.K.

Wiring in Movable Partitions

QUESTION B40—We are actively considering the installation of movable metal partitions that have wireways built into the base where both the power and phone cables are to be run.

The phone company is asking for a 4-in. separation between the phone cable and power wires. Now this is impossible in a 3-in. metal partition.

1. *What portions of the NEC cover this type of installation?*
2. *What effect will the closeness of the power cables have on the telephones?*
3. *What other problems can we anticipate in this installation?—J.A.M.*

ANSWER TO B40—The applicable portion of the 1959 NEC covering installation of power conductors and communication conductors as covered in Paragraph 800-3(a-2) is as follows:

1. Paragraph 800-3(a-2) states: "Communication conductors shall not be placed in any raceway, compartment, outlet box, junction box, or similar fitting with conductors for light and power circuits or

Cable's best friend

General Electric silicone rubber insulation protects against heat, overloads, ozone, aging, moisture and radiation

Double Capacity, Overload Protection — When used to insulate cable, silicone rubber gives you up to *twice* the current capacity, *twice* the overload protection as ordinary insulation. The superior electrical properties and wide operating temperature range of silicone rubber are the reasons.

Greater Reliability, Longer Life — G-E silicone rubber insulation has long service life at temperatures from −55°C to 200°C, and it is virtually ageless under severe conditions of heat, ozone, sub-freezing, moisture, and radiation. Trust it to keep working long after ordinary insulation fails.

Possible Cost Savings! What's the price difference? More often than not, *none at all.* In old installations, use it in *existing* conduits. Capacity and protection goes up, costs go down. On new installations, you are buying the extra capacity and overload protection needed in the years ahead. Sound electrical insurance.

Get the full story on cable's best friend: silicone rubber. Write: General Electric Company, Silicone Products Dept., Section DD1060, Waterford, New York.

GENERAL ELECTRIC

Class I signal and control circuits unless the conductors of the different systems are separated by a partition; provided, that this shall not apply to conductors in outlet boxes, junction boxes or similar fittings or compartments where such conductors are introduced solely for power supply to communication equipment or for connection to remote control equipment."

It appears to me that in view of the NEC minimum requirements, using the contemplated wireways and 3-in. metal partition separation, J.A.M. is not violating the NEC.

2. The metal partition will screen the inductive coupling effect due to power and lighting load. Be sure the raceway is bonded to a good ground.—E.J.M.

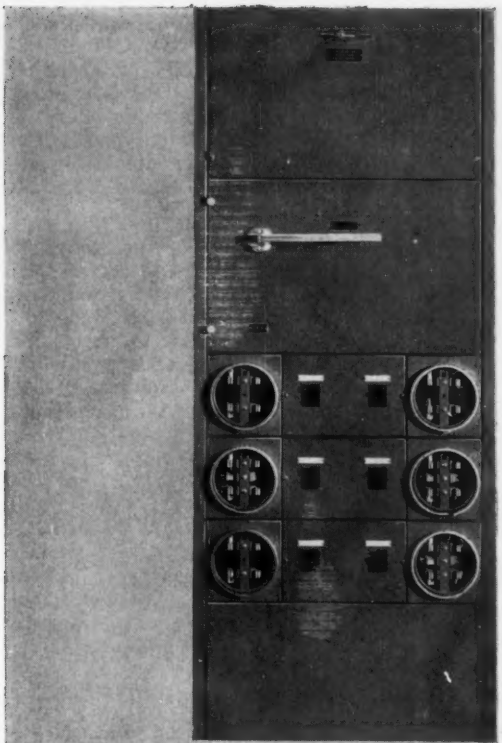
Part-Winding Starting

QUESTION C40—What is the difference between a 240-volt, 3-phase part-winding motor, and a 240/480-volt motor as far as the windings are concerned? It seems to me that the 240/480-volt motor on the lower voltage can also start on one winding and run on two windings.—H.S.

ANSWER TO C40—This question is a good one and will create quite some interest among EC&M readers. What is the difference between a 240-volt, 3-phase part-winding-start motor and a 240/480-volt dual-voltage motor? Schematically there is very little difference, except the part-winding-start motor has two identical parallel windings and in conjunction with a suitable starter (increment) the motor winding is never disconnected from the line during switching, providing smooth acceleration with reasonable starting torque.

As to the 240/480-volt dual-voltage winding motor, according to the schematics, this motor could be started on one winding then operated on both (parallel-connected) motor windings. Unfortunately and without going into the theoretical aspects of dual-voltage wound motors, if started on one half of the motor winding, the motor has no pull-in pull-out torque and therefore is not adaptable or applicable as a part-winding-start motor.—C.B.

ANSWER TO C40—Electrically there is no difference between a 240-volt 3-phase part-winding



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WALL MOUNTED

Takes up less space on walls ▪ No "pull box" needed ▪ Factory-assembled and completely bussed ▪ Up to 600 Amp Main ▪ Stocked by distributors

I-T-E

METERING SYSTEMS CROSS BUSSED TO GO UP QUICK!

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motor and a 240/480-volt motor. Each motor has two 240-volt, 3-phase windings. The part-winding motor uses one winding to start and one to two seconds later the second winding is energized. The dual-voltage motor uses two 240-volt windings in parallel for 240-volt operation.—C.W.M.

EDITOR'S NOTE—According to Paragraph MG-1-1.10 of NEMA Standard MG-1 (Motors and Generators), a 240/480-volt, dual-voltage motor seems to meet the NEMA definition of a part-winding-start motor. However, Paragraph MG-1-6.17 of the same standard adds a word of caution about using the 240/480-volt motor with a part-winding starting arrangement. Briefly, this paragraph points out that not all such dual-voltage motors are suitable for this application. The deciding factor has largely to do with the distribution of the two stator windings, which in turn determines starting currents and torques when 240/480-volt motors are started on one winding. As indicated by NEMA, the best bet is to check this important point with the manufacturer of the particular motor before using it wtih a part-winding starter. —J.H.W.

Can You Answer These QUESTIONS?

QUESTION L40 — An associate claims that a duplex receptacle rated at 15 amps, 125 volts, can be used to supply power to two 15-amp circuits through the two plug caps inserted into the duplex receptacle. I maintain that the receptacle is rated at 15 amps, and that the total current that can be drawn from it is 15 amps and not 30 amps. Who is correct?—J.A.M.

QUESTION M40—In our grinding department we have several 550-volt motors on the same feeder, but all are individually controlled. Motors range in size ¼ hp to 3 hp. We would like to have an exhaust blower run every time anyone of these machines are started. These motors are spread out, so it would not be practical to have a separate contactor plus the extra wiring involved to accomplish this in the conventional way.—E.M.

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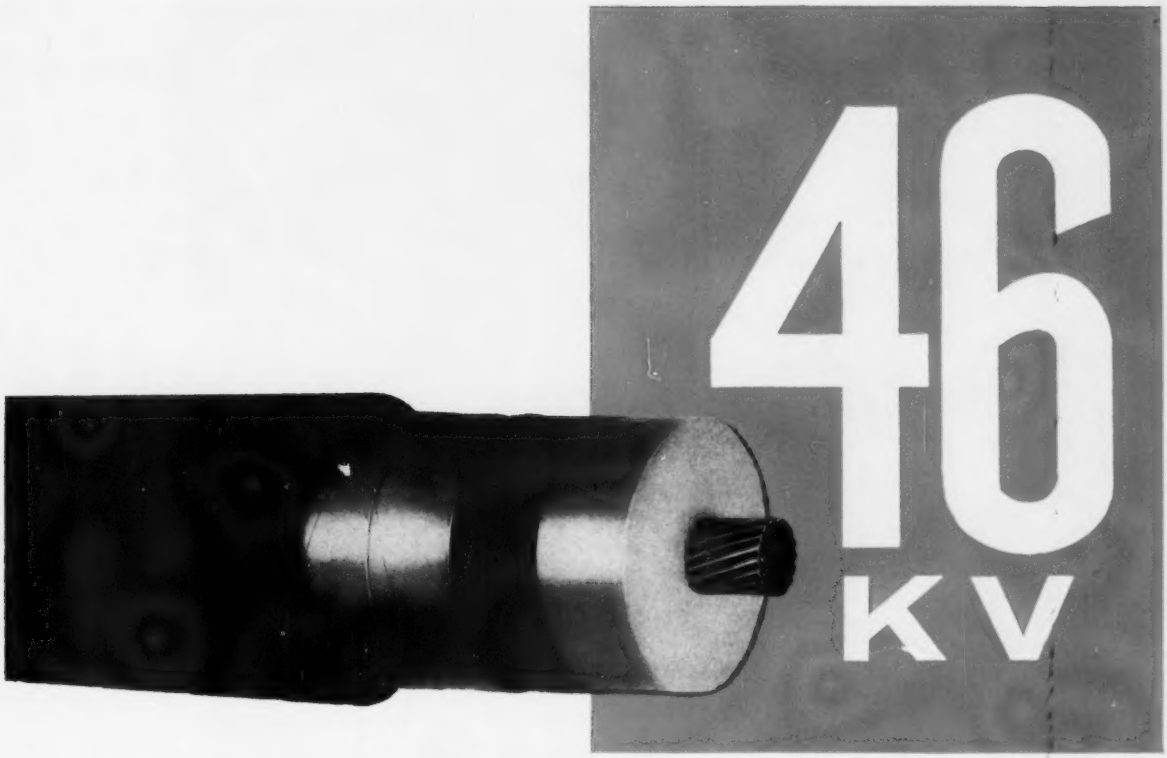

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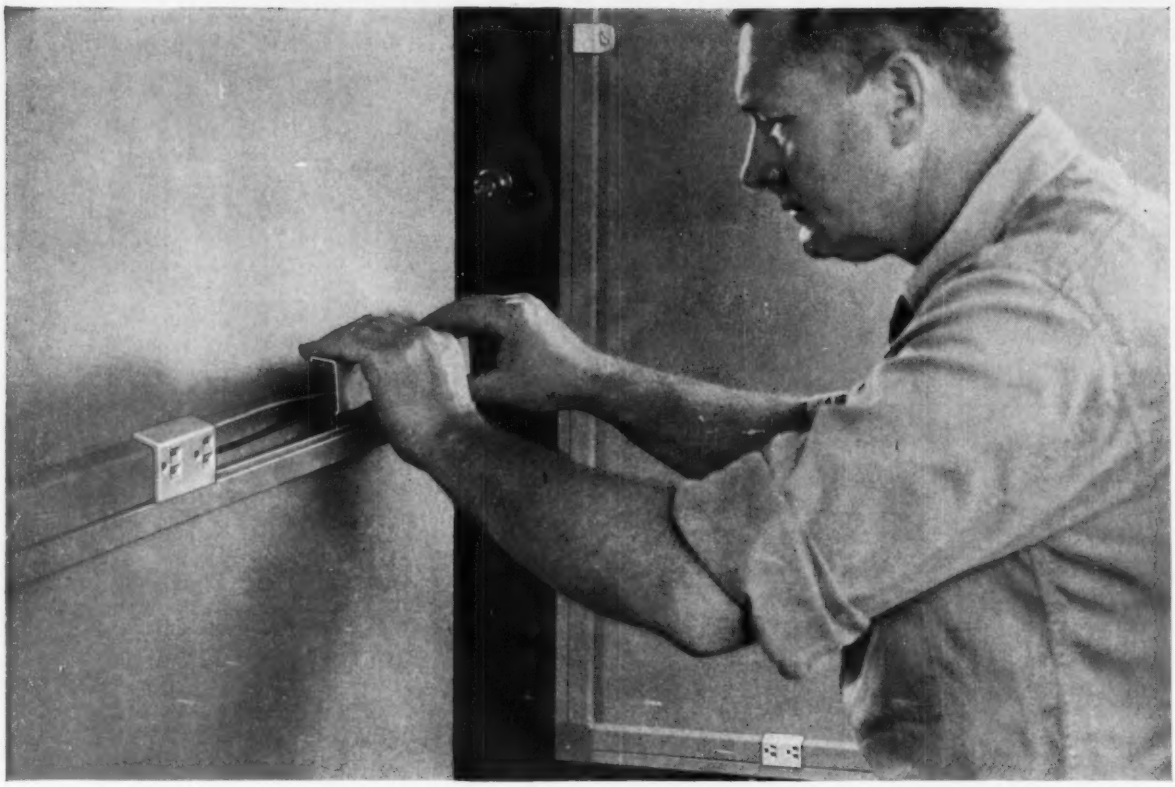

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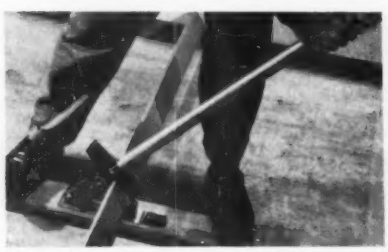

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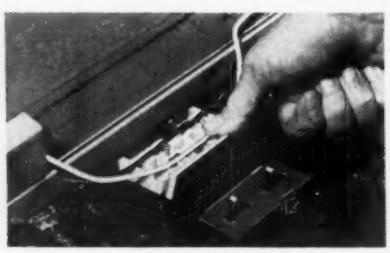

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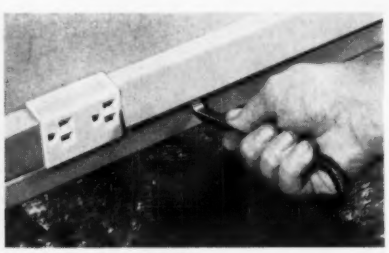

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Questions on the Code

Answered by:

R. L. LLOYD, *Electrical Safety Engineer, National Bureau of Standards, Washington, D. C.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

READERS are invited to submit questions regarding the National Electrical Code and its practical application to this Department. Questions are answered by the consulting editor whose initials appear at the end of each item. The views and opinions expressed are, in each instance, those of the individual consultant replying and are not necessarily those of his employers, of this publication or of a Code-making committee or panel on which he may serve in an official capacity.

Grounding In Outbuildings

Q. *Is it permissible to run a 3-wire, 30-amp UF cable with ground as a subfeeder from a house to a garage located apart from each other? The subfeeder will feed a 4-circuit CB panel.*

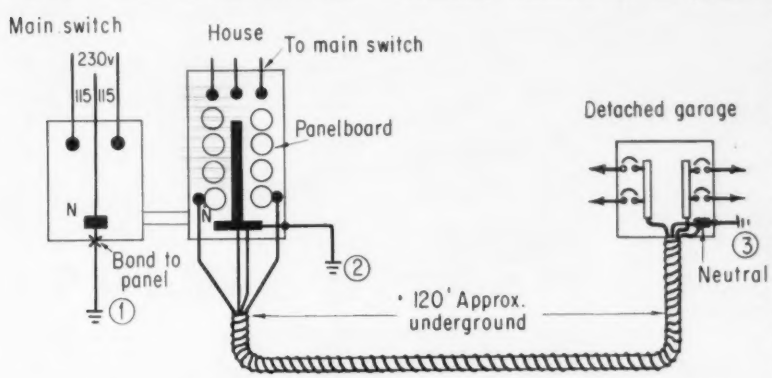
The section I am concerned with is Section 250-24, the part which says "any building housing equipment required to be grounded or utilizing two or more branch circuits."

Is it permissible to do it the way I have illustrated or must a separate grounding electrode be driven? —J.M.L.

A. According to the provisions of Section 250-24, the neutral conductor of the 3-wire subfeeder serving the garage must be connected to a grounding electrode located at the garage. Reference to Section 250-54 indicates that such a grounding electrode shall serve the dual purpose of grounding the neutral conductor of the system, and also the metallic enclosures and equipment in or on that building. Such an electrode is called a common grounding electrode. Under such circumstances, a fault is rapidly cleared through a low-impedance ground circuit. If we do not install a common grounding electrode, as shown at point No. 3 in the illustration, the impedance of the grounding circuit would be increased in proportion to the distance between the two buildings, and the size of the copper in the grounding circuit. In view of the foregoing, the proposed method of procedure does not, in my opinion, satisfy code requirements.

Many years ago when the code did not recognize the grounding of the neutral conductor at the building served, such as the garage in question, the method proposed by you occasionally was applied to the overhead conductors supplying the various buildings on a farm occupancy. A grounding conductor, solely for the purpose of grounding equipment, was installed on the pole line. Such procedure eliminated the high-impedance ground circuit which often prevailed when a circuit through earth became a questionable safeguard. The creeping meter due to faults which could not be cleared through earth, and the high fatality rate of farm livestock form the background of the present provisions of Section 250-24.

According to your diagram, it is significant to note the common grounding conductor at the panelboard located in the house, as shown at point No. 2. This is in violation of Section 250-23 which requires the connection on the supply side of the service disconnecting means. As a result, the grounding of the system and service equipment must be made at the main switch as shown at point No. 1 on the diagram, or possibly at the meter location. The grounding procedure shown at the garage is covered by Section 250-24.—B.A.McD.—10/61/1



3 No. 10 UF cable with No. 10 grounding conductor
The neutral buses of both panels are bonded to the metal of the panels.

Show Window Lighting

Q. *There seems to be a conflict between Section 220-2(c), Exception No. 2 and 220-4(b).*

The first paragraph says you "may" and the last reference says you "shall."—B.C.F.

A. There is no conflict. In the case of the branch-circuit requirements in Paragraph 220-2(c), Exception No. 2, this paragraph states that the branch circuits in the show windows shall basically be sufficient for the actual load within these windows. The actual load may be less than that obtained by the 200 watts per-linear-foot requirement, or, as it is in many cases, it may be considerably more than this minimum requirement.

In Paragraph 220-4(b), it is required that the feeder size at all times shall include this minimum load for show-window lighting. Here again, it may be argued that the show windows are not going to be furnished with this much lighting, i.e., the minimum of 200 watts per foot. Actual experience has shown, however, that within time, and there are many cases on record to back this up, the lighting in these show windows is quickly increased to this minimum value; and in most cases the load is increased far beyond this minimum value.

In the case of the branch circuits, it is usually not too much of a problem to provide sufficient additional

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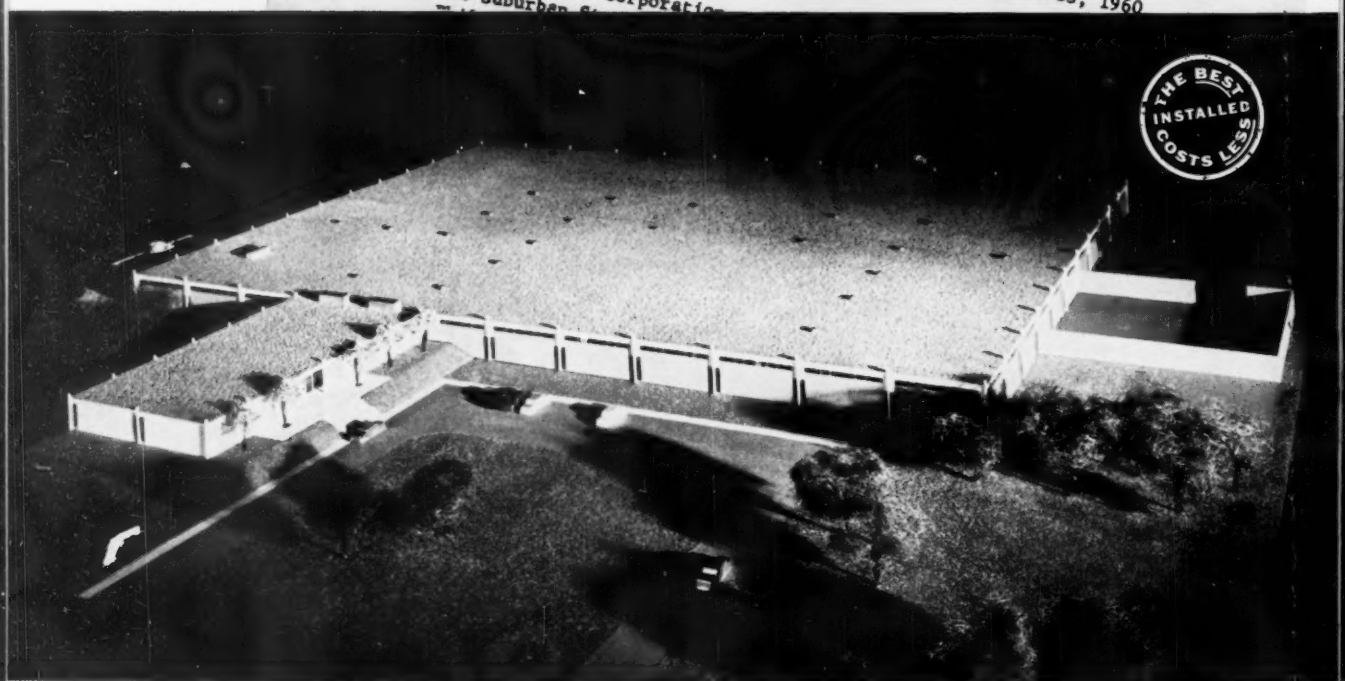

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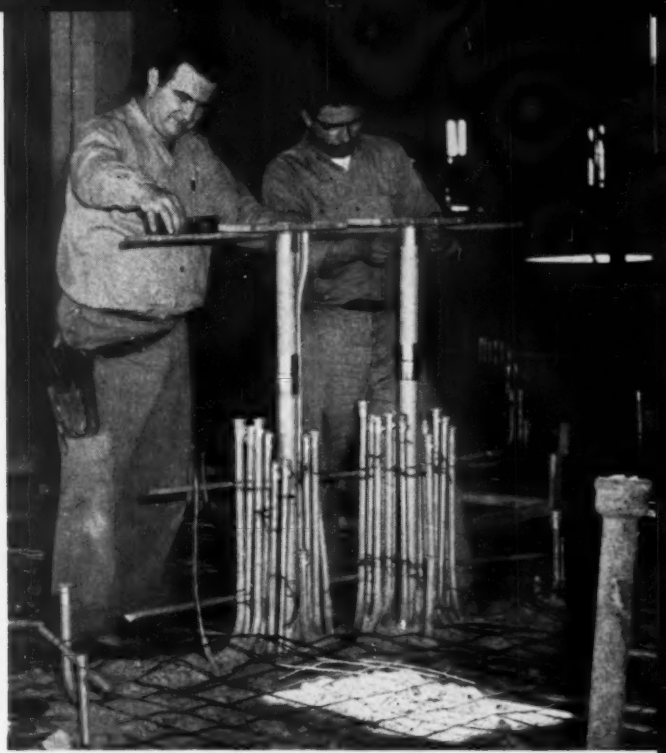

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branch circuits to take care of a later increase in the show-window lighting. In general, the physical installation and the actual expense involved in providing the additional circuits is not of such magnitude as to make additional branch-circuit installations prohibitive. However, trying to replace the feeder circuits to accommodate for additional lighting in a show window at a later date can be quite a prohibitive task from a cost standpoint, and also from the standpoint of actually trying to replace the feeder as a physical problem.

It has been found, in general, that these two rules have not been too hard to enforce today, because most present day designs of show windows provide initially for both branch circuits and feeders far in excess of these minimum code values.—B.Z.S.—10/61/2

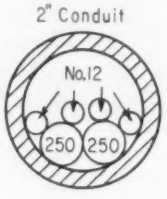
Conduit Fill

Q. *Code Table No. 1, Chapter 9, does not permit two-250 MCM Type RH cables to be pulled in a 2-in. conduit. However, if I have a condition requiring two-250 MCM RH conductors and any number of No. 12 RH conductors, from one to four, a 2-in. conduit would be ample. See the computations in Fig. 1.*

Therefore, would there be any code violation if I pulled two-250 MCM, Type RH conductors in a 2-in. conduit with say two No. 12 RH conductors, as a ruse, or with an excuse that the two No. 12 RH conductors will be used for a future circuit?—A.F.D.

A. According to Table 1 of Chapter 9, the maximum number of conductors in conduit or tubing is "based upon the percent conductor fill, Table 3, Chapter 9, for new work." This is quoted from the heading to Table No. 1. While Table No. 3 covers a combination of conductors not included in Table No. 1, it appears that the percent area of a conduit varies with the number of conductors involved. When two conductors are concerned the maximum fill is 31%. For three conductors the fill is 43%, and for four or more conductors the fill is 40%.

According to Table No. 1, only one 250 MCM conductor is permitted to be installed in a 2-in conduit. This is based on a 31% conduit fill. As shown by Fig. 2, two-250 MCM conductors have an area of 1.1834 sq in. 31% of the area of a 2-in. conduit is 1.04 sq in., which is not sufficient to accommodate two-250 MCM conductors. On the basis of a 40% fill, the 1.34 sq in. area is sufficient to accommodate two-250 MCM conductors, but such a fill is not recognized. According to Table No. 3, which covers a combination of conductors as shown by Fig. 1, two-250 MCM and four No. 12 conductors may be installed in a 2-in. conduit, on the basis of a 40% fill. According to Table No. 1 only one 250 MCM conductor is permitted in a 2-in. conduit, and according to Table No. 3 we may install the six conductors shown in Fig. 1. Such is the paradox which appears to prevail, and in the absence of code advice it is difficult to resolve the apparent inconsistency with a background of authority. On the basis of sound logic, however, it appears inconceivable that the fill shown by Fig. 1 ever was intended. As a result, the ruse by which you propose to circumvent that what appears to be the intent of the code should be criticized, and the code should be revised



Tables 5 and 4
Area 2-250 MCM RH wire = 1.1834 sq. in
Area 4 No.12 RH wires = 0.1536
Total wire area = 1.3370 sq. in.*
Table No. 4: 40% of area of 2" conduit = 1.34 sq. in.*

Fig. 1

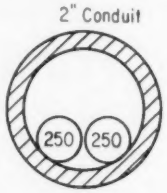


Table 1
Area of 2-250 MCM RH wire = 1.1834 sq. in.*
Table No. 4: 31% of area of 2" conduit = 1.04 sq. in.*
Not large enough to accommodate 2-No. 250 MCM wires.
40% of 2" conduit = 1.34 sq. in.*

Fig. 2

Table No.1
Area of 3 No. 6 RH = 0.3714 sq. in.
Table No. 4: 43% of area of 1" conduit = 0.37 sq. in.
40% of 1" conduit = 0.34 sq. in.

Fig. 3

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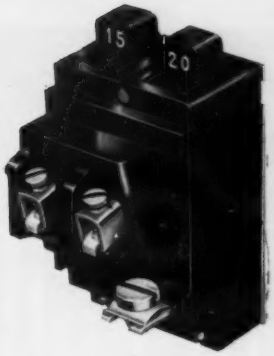

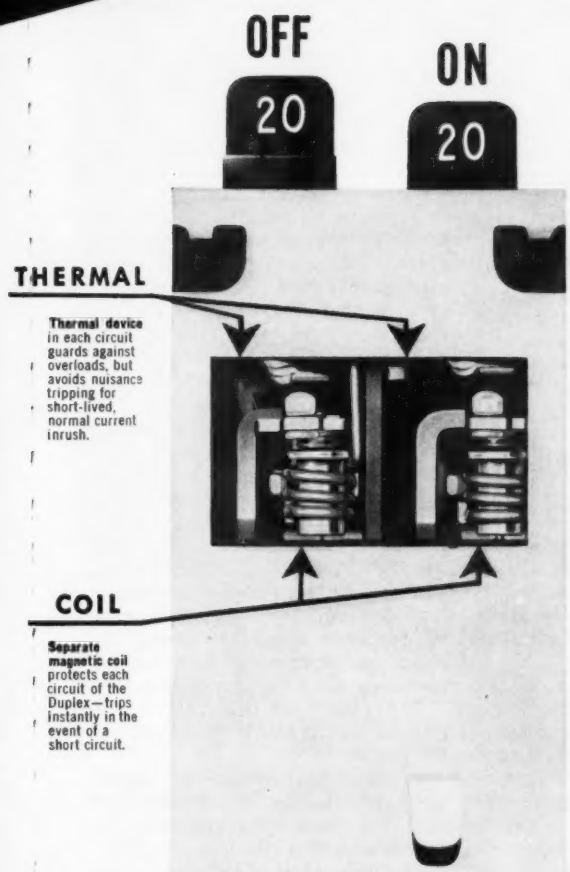

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accordingly. Perhaps a fine print note following Table No. 3, reading as follows, would suffice:

"Whenever a combination of conductors consist of two conductors of the same size, larger than any of the other conductors, and subject to a 31% fill, the entire combination of all conductors shall be limited to a 31% fill."

Fig. 3 shows how three No. 6 conductors may be installed in a 1-in. conduit on the basis of a 43% fill.—B.A.McD.—10/61/3

Switch Enclosures

Q. *Section 373-8 prohibits the use of switch enclosures as junction boxes, troughs or raceways. We checked several disconnect switches and found the available space between the switching mechanism and the enclosure varies greatly from manufacturer to manufacturer and from fusible to non-fusible switches. The use of a junction box or wireway appears costly, unsightly and cumbersome in many cases. The available wiring space, wire size, switching mechanism, and individual installation should all be considered in the formulation and enforcement of this section. Does this section also apply to those commercial devices known as motor starters? If so, what recommendations are offered for the connection of remote control stations, interlocking circuits, and other control or signal circuits? —E.A.G.*

A. The provisions of Section 373-8 are quoted as follows: "Switch Enclosures. Switch enclosures shall not be used as junction boxes, troughs or raceways for conductors feeding through or tapping off to other switches, unless designs suitable for the purpose are employed to provide adequate space for this purpose."

This rule first appeared in the 1946 version of the code. The occasion for the rule was prompted by field experience which indicated that the wiring spaces within the standard enclosures designed for the accommodation of a knife switch was not sufficient to accommodate other conductors feeding through or tapping off to other switches. In the absence of any specific rule, such boxes often were crammed with conductors to the extent that it was difficult to close the box cover. As a result, switch mechanisms in contact with the conductor insulation damaged the conductor insulation to the point that it failed.

The phrase "unless designs suitable for the purpose to provide adequate space for this purpose" provides a degree of latitude which would cover the manufacturer who provides a more liberal space accommodation. It is important to note that when the rule first appeared in the 1946 Code the exception covered "special designs." The 1959 Code deleted the word "special," which possibly indicates a more liberal consideration of the rule. Another factor which might be considered is a direct line to load connection through the switch. Under such circumstances 50% of the wire involved is eliminated. A recent G. E. advertisement, in the March 1961 issue of EC&M, features a new reversible-wiring safety switch whereby a direct feed through the switch may be obtained regardless of the location of the conduits containing the line or the load conductors.

As you say, the various characteristics involved with the design of the switch and its enclosure, and the size of conductors used, should be considered when interpreting this code rule which appears to be ambiguous. It is my opinion, when this rule was formulated back in 1946, the intent was limited to a standard enclosed externally operated switch, and not the magnetic type of line starters used for the control of a motor. This opinion appears to be verified by Abbott's N. E. Code Handbook which illustrates the switch involved. The specific question raised, however, appears to be covered by Section 430-10 which is quoted as follows:

"Wiring Space in Enclosures. Enclosures for controllers and disconnecting means for motors shall not be used as junction boxes, troughs, or raceways for conductors feeding through or tapping off to other apparatus unless designs are employed which provide adequate space for this purpose."

The intent of this rule is explained in Abbott's Handbook as follows:

"The standard types of enclosures for motor controllers and switches provide space that is sufficient only for the branch-circuit conductors entering and leaving the enclosure and any control circuit conductors that may be required. No additional conductors should be brought into the enclosure."

This rule also first appeared in the 1946 edition of the code.—B.A.McD.—10/61/4

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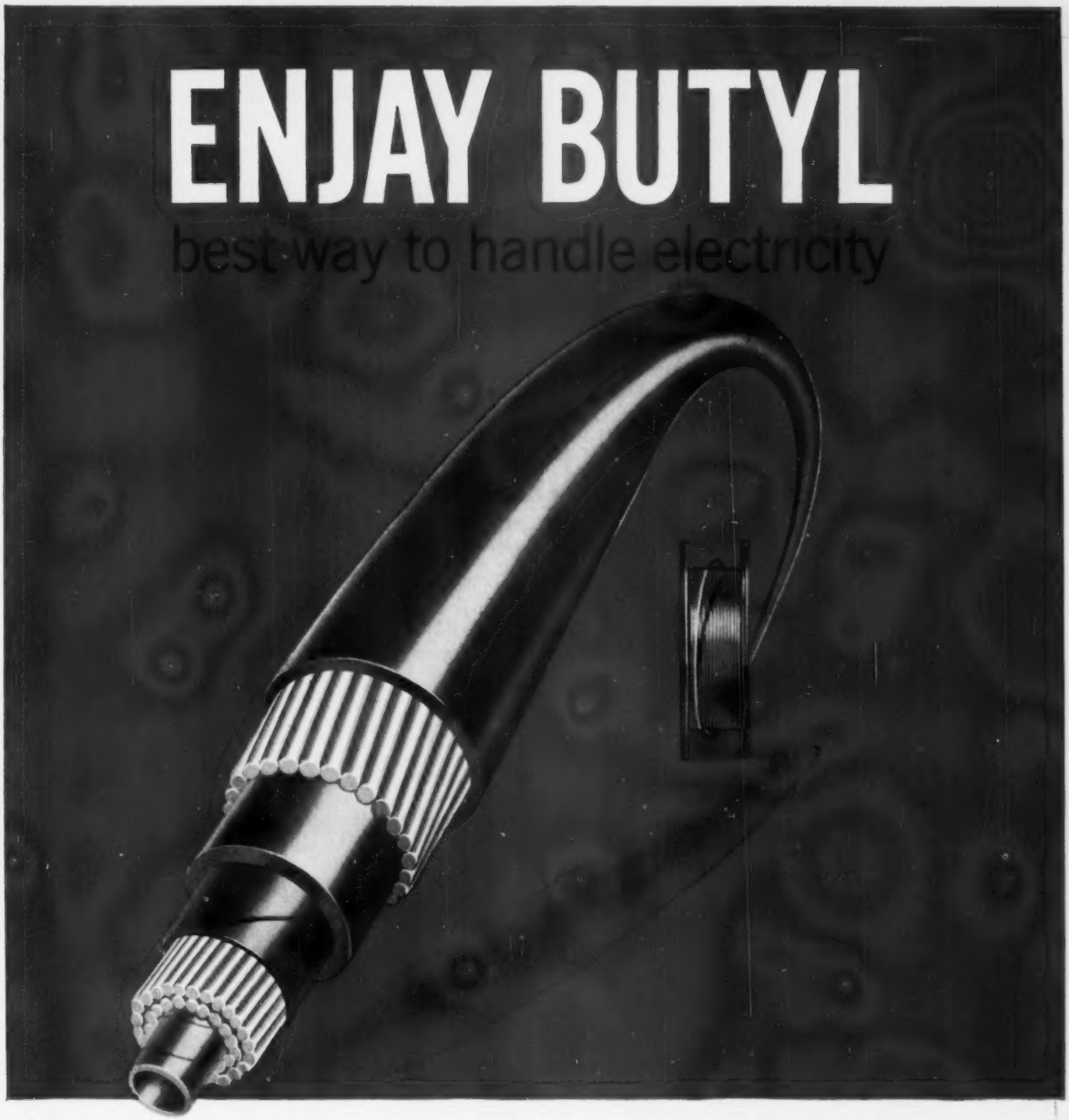

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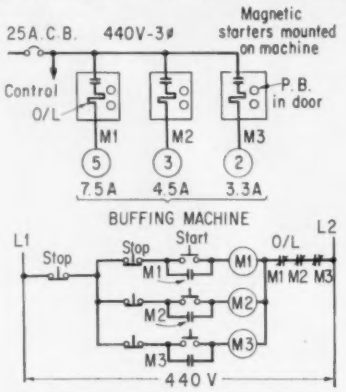
Group Installation of Motors

Q. *A question has arisen with respect to the group motor control as indicated on the diagram below.*

The answer should normally be covered under "Several Motors on One Branch Circuit" Section 430-53(b), paragraphs 1 & 2, in which requirements are:

"1. Each motor-running overcurrent device must be approved for group installation.

"2. Each motor controller must be approved for group installation."



It would appear that where the motors drive several parts of a single machine, and where an overload on any one motor starter would automatically disconnect all the motors, and furthermore, where the circuit breaker is sized for group disconnect, the use of magnetic starters with thermal overload relays would be compatible with code requirements.

Will you kindly advise the status of code rules with respect to the above procedure.—J.B.W.

A. For the convenience of our readers, the pertinent provisions of Section 430-53(b) are quoted as follows:

"b. Two or more motors of any ratings, each having individual running overcurrent protection, may be connected to one branch circuit provided all of the following conditions are complied with:

"(1) Each motor-running overcurrent device must be approved for group installation.

"(2) Each motor controller must be approved for group installation.

"(3) The branch circuit must be protected by fuses having a rating equal to that specified in Section 430-52 for the largest motor connected to the branch circuit plus an amount equal to the sum of the full-load current ratings of all other motors connected to the circuit.

"(4) The branch-circuit fuses must not be larger than allowed by Section 430-40 for the thermal cutout or relay protecting the smallest motor of the group."

Reference to UL listings of magnetic controllers indicates that the only magnetic controller listed for group installation is one manufactured by Arrow-Hart & Hegeman, Cat. No. 31403. As I recall, from correspondence with this manufacturer a few years ago, this was a special application. Generally speaking, it appears that magnetic controllers for group installations, as intended by Section 430-53(b) are not listed by UL. As a result, there appears to be two code violations involved with the wiring diagram presented with your question. The branch-circuit overcurrent device must be a fuse, and the motor controller, and its motor running overcurrent device must be approved for group installation.

The occasion for such restrictions is covered by Section 430-40 of the code which is quoted as follows:

"Thermal cutouts, thermal relays and other devices for motor-running protection, which are not capable of opening short-circuits, shall be protected by fuses or circuit breakers with ratings or settings of not over four times the rating of the motor for which they are designed, unless approved for group installation, and marked to indicate the maximum size of fuse by which they must be protected."

The smallest motor in the group is rated at 2 hp, 3.3 amps. A branch-circuit breaker rated at 25 amps results in protection which is about 7.5 times the rating of this motor. As a result, the conventional thermal-overload relays protecting the motor are not capable of opening short circuits, which could prevail due to the 25-amp circuit breaker. They could be destroyed with the possibility of a fire. It also follows that the adequacy of a 25-amp circuit breaker might be questioned on the basis of Section 430-53(b-3). The starting current of a 7.5-amp motor could vary from 250 to 150% of the motor full-load current rating. If it is 200% or lower, it appears that the 25-amp circuit breaker satisfies the code. If it is 250%, we are slightly drifting over the line established by the code. If, for example, the 5-hp. motor is marked with a code letter F to V, (see Table 430-152) the maximum rating of the circuit

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Many still give all the credit to our engine. (The efficiency of VW's 4-cylinder air-cooled car and truck engines is legendary.)

But to tell the truth, our light weight is just as important.

The engine itself is built of magnesium and aluminum alloys, one of the lightest designs in the world.

And our truck is designed without radiator, driveshaft or the heavy members used in bolted construction. For extra strength, the Volkswagen body is welded. It's all one piece.

We save 1,600 lbs. this way. A ¾-ton load you do not buy gas for.

How much gas don't you buy?

The Electric Corporation of Salem, Oregon, says they get an average of 26 miles a gallon on 3 Volkswagens.

Almost every VW owner gets over 20 miles a gallon and a few even get 30.

Our average is 24. What's yours?

breaker is computed as follows:

250 times 7.5, plus 4.5, plus 3.3 equals 26.5 amps.

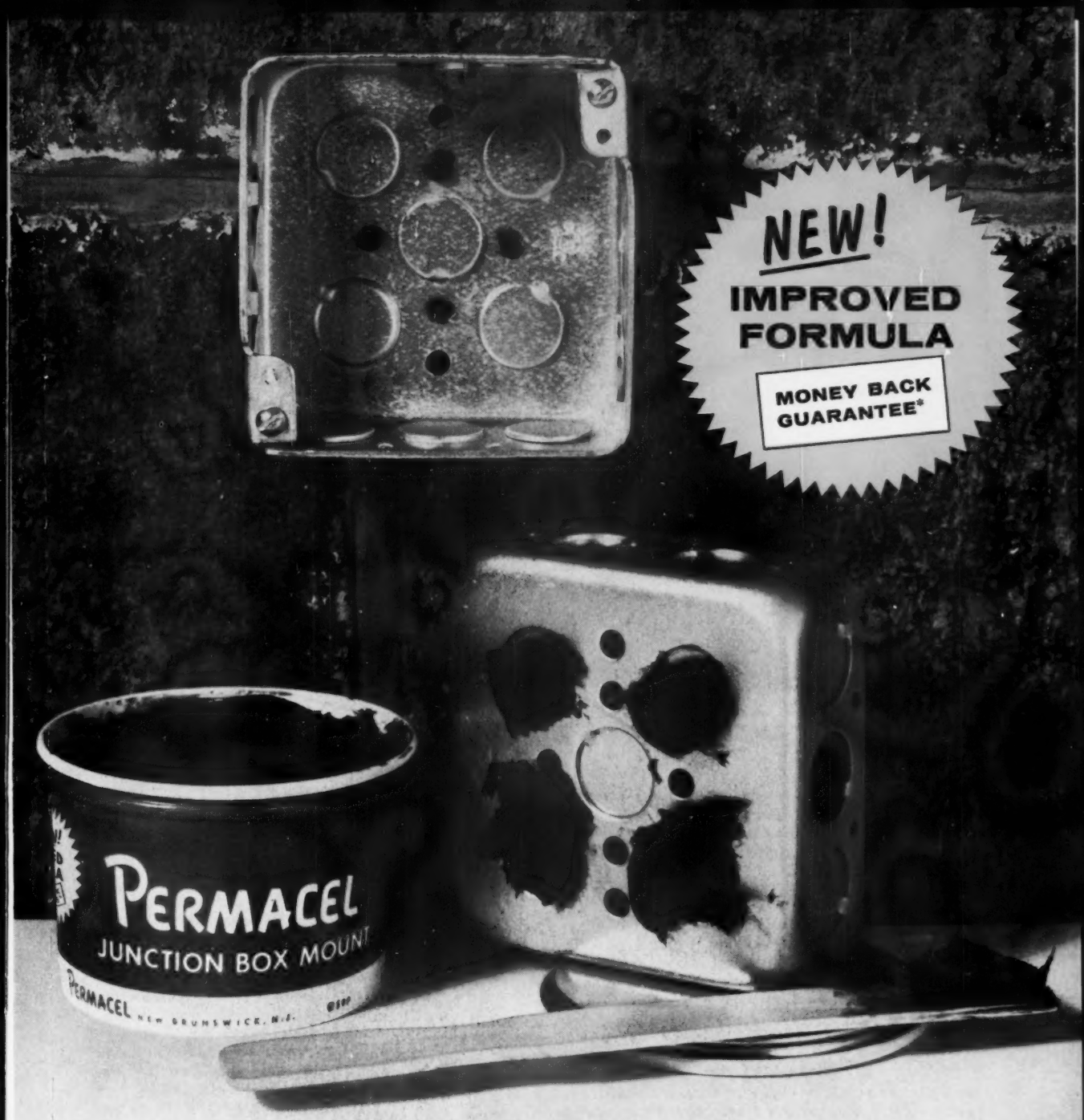
Since magnetic controllers are not approved for group installation, it appears that overcurrent devices inserted ahead of each controller would eliminate any question of a code violation.

The question that you have raised, however, is quite significant when we review the provisions of Article 670 covering machine tools. Section 670-42 of this article covers "Several Motors on One Branch Circuit." Under specified conditions, the motors serving a machine tool may be connected to a single branch circuit, and their controllers and running protective devices are not required to be approved for group operation. Section 670-1 describes a machine tool as a complete metal working machine used for progressively removing metal in the form of chips. It appears evident that a buffing machine does not qualify as a machine tool.

This article first appeared in the 1946 Code, but it was adopted as Interim Amendment No. 70 on August 4, 1942. It was the result of a study of a special committee, which considered all of the aspects involved as a machine rather than a general method of wiring. While the provisions of Section 670-42 do not require group installation, the provisions of Section 670-41 recognize the protection obtained through the provisions of group installation as covered by Section 430-53. Regardless of the rule, the fact remains that a conventional thermal relay or cutout is not capable of opening short circuits, and they should be protected by overcurrent devices rated or set at not over four times the rating of the motor for which they are designed. Section 670-32(d) recognizes this factor through its provisions for venting.

It is also significant to note that Article 670 covering machine tools is listed under the Table of Contents of the Code as special equipment. Article 430 covering motors is listed as equipment for general use. This listing indicates that rules covering general use may be supplemented or modified to cover the peculiar characteristics involved with special equipment.

Over the past few years there have been several proposals to revise the scope of machine tools to cover woodworking and plastic machines. As evidenced by the 1959 Code, such proposals have not been recognized.—B.A.McD.—10/61/5



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Lighting and Appliance Branch-Circuit Panelboards

Q. *I would like to see an explanation of the following items taken from the NEC:*

"Section. 384-14. *LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARD. For the purposes of this Section, a lighting and appliance branch-circuit panelboard is one having more than* 10% *of its overcurrent devices rated* 30 *amps or less, for which neutral connections are provided.*

"Section. 384-15. *NUMBER OF OVERCURRENT DEVICES ON ONE PANELBOARD.* Not more *than* 42 *overcurrent devices of a lighting and appliance branch-circuit panelboard shall be installed in any one cabinet or cutout box."*

*The term "*42 *overcurrent devices" appears to me to be misleading. As it stands, a panelboard designed to serve a kitchen load, for example, where the diversity is high and where a good number (if not all) branch circuits were* 240 *volts, with neutral, there exists the possibility of having* 84 *poles in the panelboard. The small-size circuit breakers now available could allow such a panelboard to be physically constructed.*

*It is my opinion that the term should read "*42 *poles" instead of "*42 *overcurrent devices." In this way the panelboard could have single-,* 2- *and* 3*-pole devices as long as the total poles used did not exceed the* 42 *total. If the NEC is taken literally, it would be possible to load up a panelboard (with the small* 5000*-amp I. C. rated CBs) to the point where the available short-circuit capacity would be greater than the small breakers could handle with the possibility of serious injury available.*

In my practice, I use the term "poles" in place of overcurrent devices to avoid such difficulties.

In reviewing the NEC, I do not find any limit on the numbers of breakers that may be installed in one box or cabinet for panelboards other than lighting and appliance loads.—W.R.B.

A. The provisions of Section 384-15 stem from a similar provision which appeared for the first time under Section 1303-g of the 1933 Code. It is quoted as follows:

"The number of circuits of a lighting branch-circuit panelboard installed in any one section of a cabinet shall not exceed 42 where

one automatic overcurrent protective device per circuit is used or 20 where two overcurrent devices per circuit are used."

The occasion for the rule was described as follows: "The purpose of the above new rule is to avoid the overheating that has occurred in some instances where unusually large panelboards have been installed."

This rule was slightly revised in the 1937 edition of the code by the replacement of the phrase "lighting branch-circuit panelboard" with "lighting and appliance branch-circuit panelboard."

The next revision, which is identical to that now covered by Section 384-15, occurred in the 1946-1947 edition of the code.

"Not more than 42 overcurrent devices of a lighting and appliance branch-circuit panelboard shall be installed in any one cabinet or box."

Previous to the 1946 Code, the question of a 1- or 2-pole overcurrent device was specifically covered. It did not, however, cover the 3-pole devices common to 3-phase, 4-wire, 120/208-volt branch circuits, or the 4-pole devices that could be used with 2-phase, 5-wire circuits. Prompted by a desire to minimize, what might be referred to as unnecessary explanations, it appears to me that the members of Panel No. 9 decided that the literal reading of the rule expressed the intent that an overcurrent device, regardless of the number of poles involved, would be considered as one for a single-pole device, two for a 2-pole device, and three for a 3-pole device. As evidenced by your question, it appears that the intent is questionable and some action should be taken in the interests of clarity.

According to your concept of the rule, we could have as many as 84 poles, which to me is equivalent to 84 single-pole overcurrent devices installed in a cabinet. Applying the same logic to a 3-phase, 4-wire branch circuit, we could have as many as 126 overcurrent devices installed in a cabinet. Since each one of these devices carry current and generate heat, it appears obvious that the occasion for the rule would not be satisfied if we limited the overcurrent devices to 42 when single-pole devices were used, and at the same time recognized 126 overcurrent devices when three poles are involved.

In order to clarify this question, it appears to me that a brief fine-print note as follows should be inserted at the bottom of Section 384-15:

"When 2-, 3- or 4-pole overcurrent devices are used, they shall not be considered as constituting a single overcurrent device."

As you say, the number of overcurrent devices, which is installed in a box or cabinet for panelboards, other than lighting and appliance branch-circuit panelboards, is not covered by the code, and there appears to be no restriction other than a personal concept of good wiring design.

It is also significant to note that the provisions of Section 384-16 which cover the 200-amp overcurrent protection for lighting and appliance branch-circuit panelboards, applied to all types of panelboards back in 1942. Interim Amendment No. 59, approved August 11, 1942, required all panelboards to have overcurrent protection as now covered by Section 384-16. This I. A. prevailed until the 1953 edition of the code when it was revised to apply only to lighting and appliance branch-circuit panelboards. In the absence of any official advice with respect to this distinction recognized by the code, one is inclined to believe that questions of practical consideration were involved. — B.A.McD. — 10/61/6

Pull Boxes In Conduit

Q. *Is there a rule in the NEC that requires a pull box every 50 ft in a horizontal run of conduit? The conduit will be in a straight line with no bends.—B.L.D.*

A. There is no such rule in the NEC. Section 370-18, the subject being pull and junction boxes, gives minimum dimensions of pull boxes for different pulls with other information concerning pull boxes but no mention of the requirements concerning distance between such pull boxes. The "Design Manual on Steel Electrical Raceways" published by American Iron and Steel Institute has the following statement:

"Pull and Junction Boxes.

"Pull boxes and junction boxes should be considered an integral part of the wiring system. In long conduit runs, they provide the necessary access points for pulling and feeding conductors into the raceway. They can be effectively used as T, X and right-angle junctions for single or paralleled groups of conduits, and as offset facilities to carry conduit circuits around building or other pipe or duct obstruc-

tions. Wherever the number of required bends and offsets in a conduit run exceeds the maximum permitted by the code, pull boxes should be installed to facilitate conductor installation.

"The advantage of a pull box is that it provides more work space. The greater the box dimensions, within structural limitations, the easier it is to install cables, make taps, install cable supports, or to train the conductors. Field experience proves that it is false economy for the designer to skimp on the size of junction or pull boxes.

"Standard outlet boxes are readily available for smaller size conduits, but for larger size conduit installations pull boxes are generally of special design and custom built to fit the job. To insure sufficient working space in such units NEC Section 370-18 specifies minimum dimensions for raceways 1¼-in. and larger, and containing conductors of No. 6 and larger."

Good engineering practices should be followed in the placing of pull boxes in the raceway with careful consideration being given each installation as to the size of the conduit, the conductors to be used and the distances involved. It would be hard to write specifications that would cover each installation under one general rule, and I am sure for this reason the placing of pull boxes is a matter for the engineer in charge to specify on each job.—R.E.W.—10/61/7

Appliance Circuits

Q. *Could the NEC be worded to specify two 20-amp circuits in the kitchen, instead of the wording two or more for kitchen, pantry, laundry, breakfast room, etc. Experience has shown that at least two are needed just in the kitchen.—W.J.G.*

A. It should be noted that while Paragraph 220-3(b) of the code requires two or more 20-amp branch circuits for the small appliance load, Paragraph 220-3(c) specifically requires additional branch circuits for other specific loads. So any inspector is certainly within his jurisdiction to require two or more branch circuits within the kitchen area only if to his knowledge specific pieces of electrical equipment, which will not be safely handled by the one or two appliance branch circuits, will be placed in this kitchen area.—B.Z.S.—10/61/8

Shop Versatility Pays Off

A Syracuse, N. Y. motor shop has geared their operation to handle all motors—large and small. Steady customers and increased profits are the result.

ROY S. BOWSER, operator of the Salmon Motor Repair Service Inc., Syracuse, N. Y. stands in front of shelves containing preformed stator windings for common-type fractional horsepower motors. Coils are made in advance on anticipation of future replacements. The steel storage shelves, constructed by the firm, are typical of those throughout the shop.

IT DOESN'T make any difference to the Salmon Motor Repair Service, Inc. what type of motor comes through the door, they are equipped to handle the repair job. Such has been the attitude of this long-established versatile motor shop for many years.

A visit to this well-equipped shop attests to their versatile operation as indicated by the accompanying photos. They were just putting the finishing touches to a newly wound stator for a 150-hp synchronous motor, repairing a large dc generator, and overhauling a 400-cycle generator. And in their fractional horsepower department, small motors of various types were in the process of repair.

The firm designed and built most of their own tools and equipment such as the bake oven; pay-out magnet-wire reel stands; burn-out/spray enclosure with associated equipment; dynamic balancer with strobe light; and metal storage shelves.

Repair of heavy motors is done at the rear of the shop, which is adjacent to loading entrance. Heavy equipment can then be loaded or unloaded quickly with only short sections of overhead hoists required.

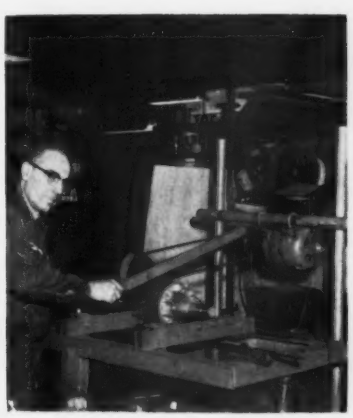
At the front section of the shop, fractional motors are repaired.

Because of a broad knowledge of all types of fractional motors, the firm has been able to anticipate future demands for coil replacements of certain motors. As a result, they have made up a sizable supply of spare coils, which enables them to provide quick service for such motor repair jobs.

With many types of fractional motors, Roy S. Bowser, one of the firm's officials, stated that they have found it less expensive to purchase stator assemblies from the motor manufacturer. Here again, their past experience dictates the size of stock for various parts that should be maintained.

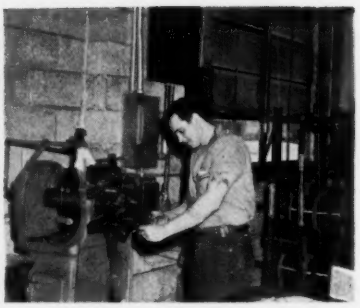
At the coil-winding machine, a magnetic-wire pay-out stand simplifies feeding wire from reels to coil former. As shown in an accompanying photo, the payout stand consists of vertical steel members rigidly braced together. Height of the frame structure is about 5 ft and width about 2½ ft. Openings at each end of the stand permit the insertion of horizontal pipes, which support magnet-wire reels. Then as wires are paid out from the reels, they pass through an opening in an

SMALL MOTOR REPAIR operations are handled at the front end of the shop to provide faster pickup and delivery service. Mechanic at left is shown removing stator windings from an odd-type single-phase motor. Vertical pole, extending from work bench, supports test jumper leads, used in checking out connections.



SHOP MECHANIC demonstrates the operation of their custom-made dynamic balancer. Pulley arrangement spins rotor assembly as mechanic presses pully assembly down against it. The support on the right of the bedplate secures a strobe light. The strobe light locates any point of the rotor that is out of balance.

TWO WORKMEN are shown putting the finishing touches to a rewound stator for a 150-hp synchronous drive. Final connections of form-wound coils are being made. The synchronous motor drives a dc generator, which was also overhauled. Reconditioned M-G set was quickly placed back in service.



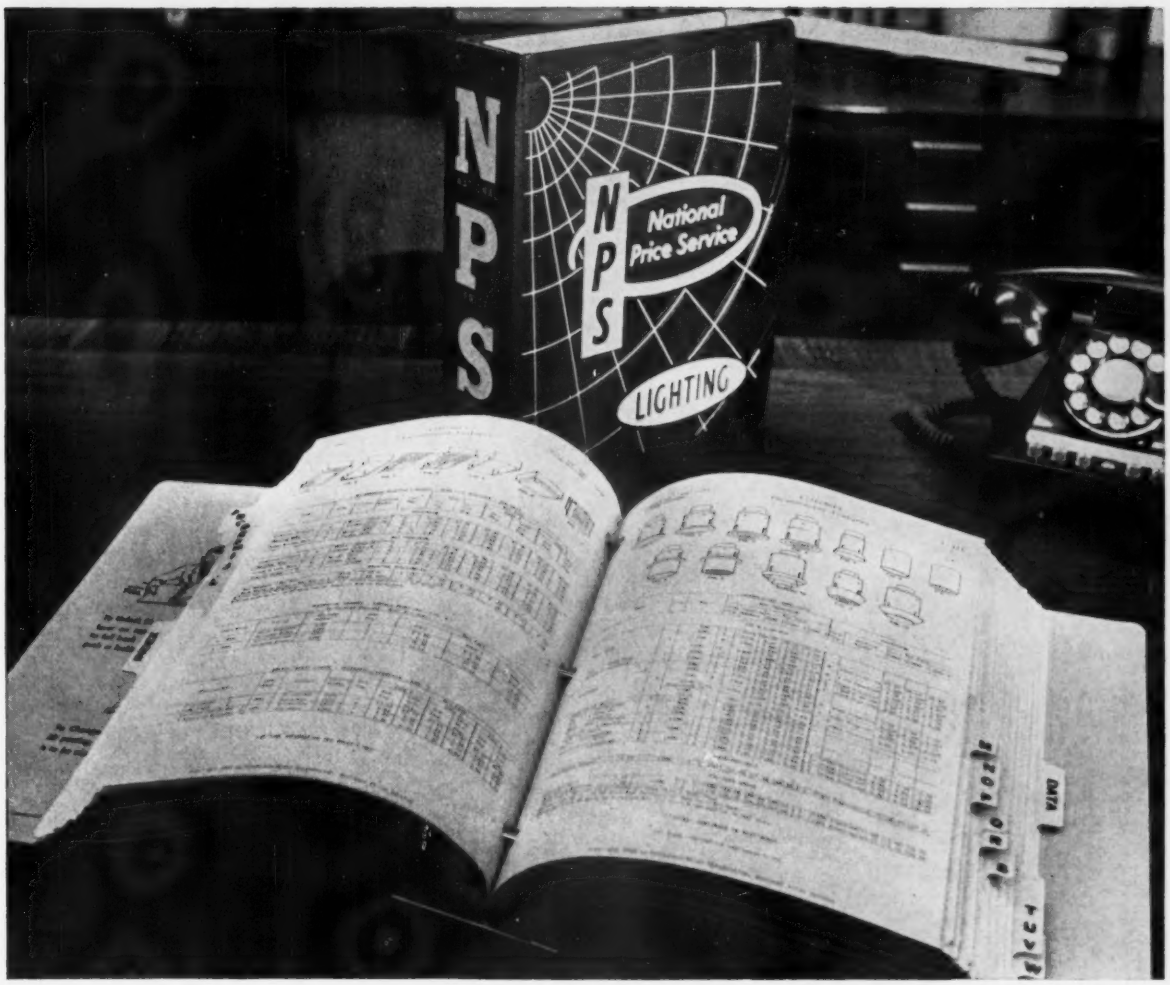
PAY-OUT STAND for magnet-wire reels are shown to right of mechanic working at coil former. This arrangement keeps wires bunched together with proper slack to simplify feeding wires to coil former. Notice long-footage wire reels, which cut time spent on replacing reels during rewinding operations. Such reels are stocked in all popular sizes of wire.

insulated block located in front of the wire reels. From there the wires extend to the coil-forming machine.

Extra-long-footage wire spools are stocked in all popular sizes to minimize replacement during coil winding operations. Wire spools are neatly stacked near the pay-out stand.

Having a rotor in balance is the key to longer bearing life and vibration-free motor operation. Salmon designed their own dynamic balancer to check rotor balance. Simple in construction, the unit consists of angle-iron bed construction with vertical pipe supports at the rear. A drive motor, U-bolted to a horizontal pipe support, which in turn is bolted to the vertical pipe, has a pulley directly connected to its shaft. Extending from the pulley end of the motor support is a flat steel lever about 2½ ft long. Toward the front, another pulley is bolted to this lever. The two pulleys are joined with a belt. Since the U-bolts that hold the motor assembly to the horizontal pipe support are not fully tight, the hand lever can be freely moved up and down. A metal guard over the lever pulley prevents contact by an operator.

Two cylindrical rollers are mounted side by side in the center of each of two horizontal cross supports, which can be adjusted to different motor-shaft lengths. After adjusting the roller supports, the shaft ends of a rotor seat freely in them, forming a circular-triangle contact. Then an operator starts the drive motor, which turns the pulley/belt arrangement. Pushing the hand lever down contacts the rotor core, causing it to rotate. An attachment holder at one end of the



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BLOW TORCH, equipped with a special tube-type enlarger tip, concentrates flame on windings being burned out. Notice circular direction of flame on windings, which prevents excessive overheating of stator-base assembly. Sturdy steel work bench, equipped with casters simplifies moving heavy stators to burn-out enclosure.

bedplate secures a strobe light, which is synchronized to and triggered by vibrating spring-mounted journals. The strobe light locates any point of the rotating rotor that is out of balance by observing markings affixed to the revolving rotor. If unbalance is detected, weights are added at appropriate points of the rotor to provide true balance.

For burning out windings, a special tube-type enlarger tip, added to a conventional torch, provides proper concentration of heat on the windings. At the same time, this method prevents excessive overheating of the stator-base assembly. As shown in the above photo, flame from the torch spreads in a circular direction throughout the windings.

Larger stator assemblies are rolled to the burn-out enclosure on a sturdy iron workbench equipped with casters. The burn-out enclosure is centrally located to one side of the shop, and it is also used for spray painting.

Another type of work performed by Salmon Motors is epoxy encapsulation of all types of coils used in areas with adverse environmental conditions.

Grinding and Brush Unit

Excellent lighting, protection against flying particles and instant elimination of dust are features of a grinding and wire brushing stand in the motor repair shop of Roy M. Butcher, San Jose, Calif.

As shown in the accompanying closeup, lamps are incorporated into

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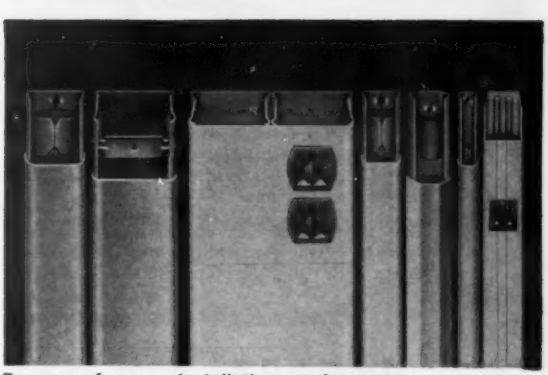

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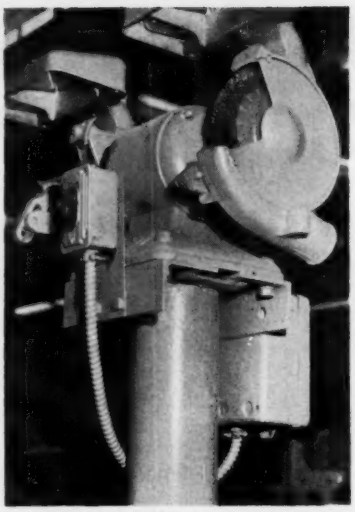
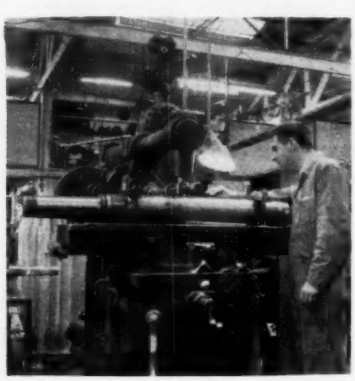


LOOKING UPWARD toward wire wheel shows positioning of lights inside hood directly above work area, also convolution of hollow casing beneath brush with nozzle connection at rear for attachment of vacuum bag.

protective hoods placed directly above the wheels. And, due to this close proximity of lamps to work areas, illumination on the work is of a high order to insure accurate inspection of jobs in progress.

It will also be noted that stop and start pushbuttons for controlling the centrally mounted drive motor are positioned conveniently at the front of the unit, while small vacuum bags may be attached to exhaust nozzles designed as part of the lower metal wheel-enclosing shields.

With wire brush (right) and grinding wheel (left) equipped with adjustable front rest for steadying instruments or blades being honed or sharpened, this combination assembly constitutes a useful item of shop equipment.



SHAFT for 350-hp synchronous motor is turned by lathe operator Paul Oberzen in machine section of Reyna Electric Works' shop in San Francisco.

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NALMCO Plans For Greater Service

The National Association of Lighting Maintenance Contractors convened in Las Vegas, August 21-24, to compare methods and know-how, review accomplishments of their brief six-year existence as a national organization, consider plans for greater future service to members, and to evaluate joint industry efforts for promoting the over-all maintenance concept.

In calling the convention to order, M. H. Galbraith stated that the first half-dozen years of NALMCO's existence could be considered as experimental or exploratory in nature, with a few geographically scattered maintenance companies informally investigating possibilities for improving their mutual image, efficiencies and service to industry.

Membership chairman Walter C. Fink, Jr., Senior Fluorescent, Atlanta, Ga., reported that membership had increased approximately 50% during the past year, while sustaining membership chairman Elmo Irwin, Lighting Service, St. Louis, Mo., reported that that category had doubled since the last meeting.

Contracts Analyzed

In numerous talks, contracts were analyzed for content, development and intent: Merlin Jones of Bunker, Jones and Co., C.P.A.s, discussing How to Intelligently Cost Contract Rates, with related accounting procedures included; Jene St. Jean defining True Service Costs; Herb Mendelsohn of Sun Ray Lighting, Kansas City, Mo., exploring possibilities for joint-venture contracts, with members in different sections of the country cooperating to serve national commercial organizations having multiple local interests, and Bill Abrams of Eveready Electric, San Francisco, considering some of the drawbacks related to such interstate ventures.

In this series of discussions it was emphasized that labor factors vary considerably due to different types and sizes of buildings, working conditions, parking and water facilities, and that non-productive labor likewise is involved in foreman supervision, ordering and checking materials. Members were also reminded that true overhead charges should consider such items as fire insurance and bid bonds, general supervision and time keeping, storage and breakage, initial freight and local job trucking, while basic labor rates should be increased in estimating to include workmen's compensation, public liability and property damage, health and welfare benefits, pension plans and vacation provisions, social security and nonproductive travel time. Sales and excise taxes, financing and interest payments, general overhead items and reasonable profit percentages likewise were considered.

In a related discussion on accounting procedures, Merlin Jones emphasized the necessity for speed, reliability and efficiency in this category, adding that accountants' statements must be presented in forms understandable to people who do not have an accountant's training or basic knowledge of technical terms and symbols.

During discussions pertaining to possible national joint-venture contracts for NALMCO members, it was brought out that although the Association is growing rapidly in membership, it not yet is sufficiently extensive in geographical coverage to guarantee nation-wide service to nation-wide industrial customers (such as chains of department stores, super markets, oil companies and the like), and that local members have neither the authority nor the knowledge to commit or guarantee services of other members in different cities or states.

MUTUAL CONGRATULATIONS were in order when NALMCO's outgoing president Melvin H. Galbraith, Approved Lighting Service, Cedar Rapids, Iowa, greeted incoming president Eugene St. Jean, St. Jean Lighting Maintenance, West Springfield, Mass., at recent Las Vegas convention of that Association.

Illustrative of this latter factor were two talks by James Watson, Fluorescent Maintenance, Denver; one talk analyzing the effectiveness of direct-mail advertising and the other discussing practical methods related to maintenance of outdoor lighting equipment. In the first of these talks, he suggested augmenting original promotional copy with lamp manufacturers' material, reprints from trade magazines, IES data, plus personal follow-ups. His second talk, on exterior maintenance, was slide-illustrated to explain different available types of scaffolds, ladders and trucks, make-up of maintenance crews, protective mountings of ballasts in pole installations, plus methods used in this category.

COMMITTEEMEN responsible for successful NALMCO conference include Bernard Brown, Bernard Brown Lighting Maint. Co., Phoenix; Bob Merriam, T. L. Rosenberg Co., Oakland; Harold J. "Mike" Hentges, Valley Flood-Lite Service, North Hollywood; Harold Marsh, Mission Maint. Co., Los Angeles; Lin W. Best, Best Fluorescent Maint. Co., Temple City, Calif., and Bill Corbett, Outdoor Lighting Service, Concord, Calif.

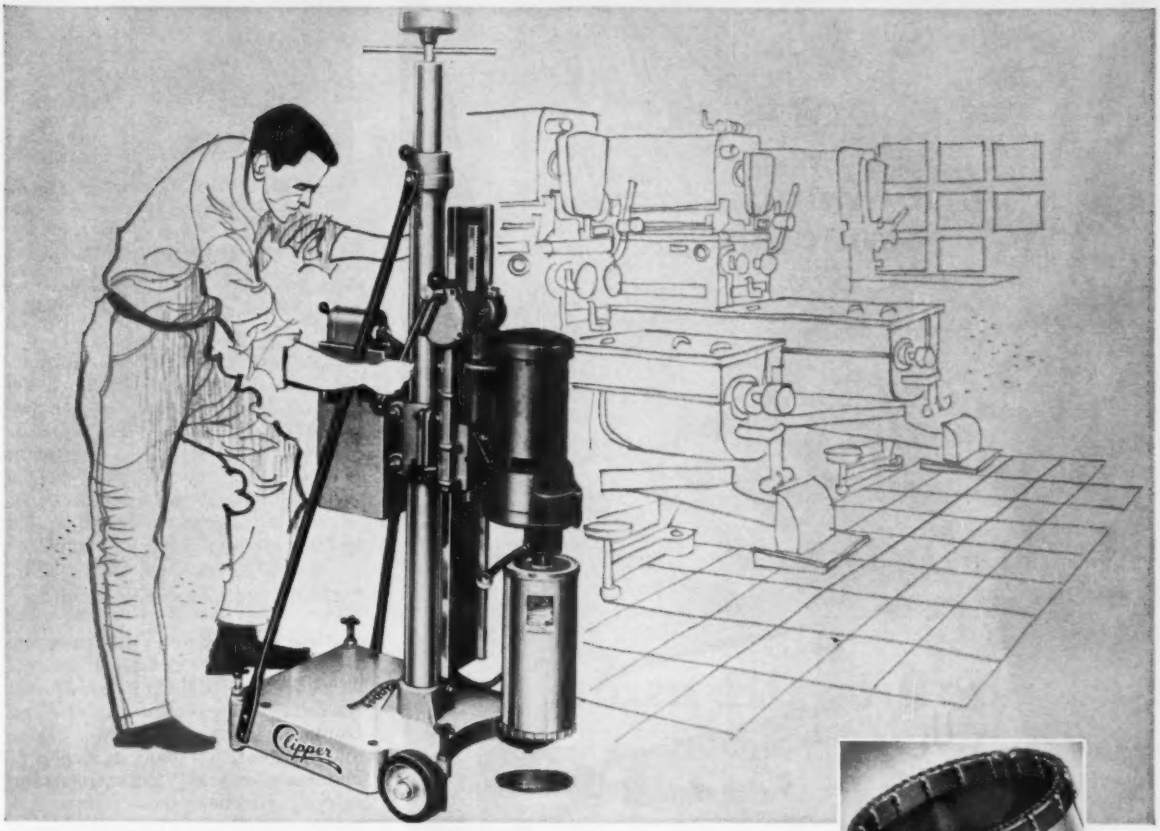
PHILADELPHIAN Barney Roth compared group-relamping experiences with George Kort, Maurys Fluorescent & Appliance Service, Louisville, Ky., during coffee break between NALMCO conference sessions at Las Vegas.

Engineered Salespower

Effective sales presentations related specifically to the lighting maintenance field were intensively considered during two 2-hour sessions directed by Cyril Wright, executive sales consultant of San Francisco. Basing his remarks on the premise that no sales presentation is effective unless it prompts listeners to react favorably, Wright contended that considerable preplanning and psychology are involved in first obtaining a prospect's attention, then creating a receptive attitude, making him think and reaching a decision. He also stated that good contracts have to include benefits for both parties, and that making intelligent decisions is not difficult if pertinent facts are first organized and effectively presented for intelligent evaluation.

In developing his topic, Wright first requested a volunteer panel of ten contractors to compile a list of typical problems faced frequently during their sales calls; as, for example, prospects not willing to admit that their lighting was bad, or the fact that they already were "buying lamps wholesale," or that they had "janitors with spare time." Each problem was then considered separately in order to emphasize customer benefits. This approach brought out innumerable plus-values, such as (1) cleaner lamps and fixtures give better quality and quantity of light, (2) better light results in faster or more accurate operations, fewer rejects and fewer accidents, (3) more production and fewer rejects mean greater profits, (4) fewer accidents reduce insurance premiums, (5) having maintenance performed by outside

CLIPPER guarantees its core drills to out-perform all others



Holes Up to 14" in Concrete in Minutes

When you buy a Clipper Core Drill you know you're buying the world's only core drill guaranteed to provide completely successful drilling. No matter how tough the drilling job, the speed of a Clipper drill remains constant, assuring faster drilling and longer bit life. In minutes, a Clipper will drill holes up to 14" in diameter through reinforced concrete, asphalt, masonry, stone and refractory products.

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ORIENTED SURFACE SET RESETTABLE BITS give maximum bit life in the hardest reinforced concrete.

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SALES PSYCHOLOGY, discussed at recent Lighting Maintenance meeting held during August in Las Vegas, was explored further between sessions by Carl Hein, T. L. Rosenberg Co., Oak and, and Harold Marsh, Mission Maint. Co., Los Angeles.

contractors with trained men, specialized equipment and methods results in lower over-all maintenance charges because it reduces necessary plant inventory, releases plant personnel for more productive operations and permits maintenance to be scheduled at times convenient to the customer.

Manufacturers Participate

Also included on the program were numerous practical discussions pertaining to lamp and ballast characteristics, circuit analysis and troubleshooting techniques, action of detergents on various types of materials, market potentials and sales approaches; these discussions being contributed by such recognized authorities as Marshall Waterman, Westinghouse, Bloomfield, N. J.; Walter Becky, General Electric, Cleveland, Ohio; Joe Schneller, Jefferson Electric, Bellwood, Ill.; Leo Duval, Jr., Sylvania, Salem, Mass., and Bob Calkins, Best Maintenance Supply.

In the first talk of this group, Waterman cited the rapid rise in mercury-vapor applications. This growth presently demands 1½-million lamps annually for replacements and new installation requirements. He also discussed the nature of mercury lighting, starting and discharge characteristics, lamp sizes and coatings, operating temperatures and life cycles, recommended fixture designs and ballast operation. In this analysis he showed that various lamp coatings could raise lumen outputs by 10% or lower them by 25%, depending upon corresponding desired or acceptable color values; that the popular 400-watt lamp is highly efficient with a 50-lumen-per-watt output, and that new designs are maintaining at least 80% of this output

Reynolds Aluminum Rigid Conduit LOWERS INSTALLATION COSTS

Here's why: Reynolds Aluminum conduit bends and forms easily and accurately. And, because aluminum is so lightweight—weighing one-third as much as steel, it can be handled and installed easily. Important to everyone concerned with maintenance is the fact that aluminum can't rust ever—and also resists corrosion due to weather and most industrial atmospheres. Even threads cut on the job can't rust.

Reynolds Aluminum Rigid Conduit is non-magnetic, reduces voltage drop, makes longer runs or smaller conductors possible.

For complete information and names of Reynolds Aluminum Rigid Conduit distributors, call your Reynolds Sales Office or write *Reynolds Metals Company, Box 2346-ET, Richmond 18, Va.*

Watch Reynolds exciting TV programs on NBC: The Dick Powell **Reynolds Aluminum Show** every other Tuesday; **Say When,** weekdays; **All Star Golf**—in living color—every Saturday.

JAMES WATSON of Denver addressed NALMCO delegates twice at recent Lighting Maintenance conference, discussing direct-mail results and outdoor lighting methods related to Fluorescent Maintenance Service practices.

over service lifespans of 12,000 hours or more.

Walter Becky's presentation, titled "Sales Prospecting," emphasized the importance of equating sales talks to customer personalities, specific needs and resulting benefits, adding that although many people cannot detect substitutions of cheap imitations for quality products, they quickly recognize reductions in quality service, and that maintenance companies offering good service at equitable prices need not fear corner-cutting competition. Emphasis on over-all service rather than upon products does not lessen the importance of efficient wash tanks, aerial ladders and relamping procedures, Becky continued, but it should be recognized that customers are less interested in your physical equipment than they are in such personal things as their seeing conditions, the appearance of their premises and reactions of their customers. Therefore it is pertinent to stress ideas and end results rather than means to those ends, inplanting sales arguments in minds of customers tactfully so they believe they are "buying" rather than "being sold."

Schneller's remarks concerning functions, problems and markets related to ballasts included comments pertaining to labelling products, explaining that Underwriters' Laboratories and Canadian Standards seals indicate compliance with nameplate ratings, safety and fire standards, but that Certified Ballast Manufacture approval additionally guarantees performance according to specifications. Schneller then reviewed ballast advances since 1945; his comments including lead-lag and series-sequence references, plus

discussion of thermosetting compounds, improved heat dissipation, reduced sound levels, reduced possibilities for shorts, explosions or dripping.

Duval's contribution was in the form of an open question-answer forum pertaining to troubleshooting in fields of fluorescent and mercury vapor lamp installations. This session brought out considerable information on circuitry and control, internal lamp pressures due to heat, starting and operating characteristics, use of instruments in testing, pre-heat and rapid-start installations, use of dummy starters and lamp testers for locating faults.

Bob Calkins' discussion on detergents included a demonstration which showed relative results obtained by various cleaning products. He also analyzed composition and actions of various soaps, as contrasted to detergents containing wetting agents for lowering surface tension; phosphates and emulsifying additives for eliminating suds and scum; concluding that this field of products now constitutes a $4-billion-a-year business.

St. Jean Elected President

Under the new set-up of NALMCO officers, the responsibilities of secretary and treasurer are now combined into one assignment, William C. Abrams, Everyready Electric Co., San Francisco, being elected for a 2-year term to handle this office. And, to lead the association in national activities for a similar period, those present elected as president Eugene St. Jean, St. Jean Lighting Maintenance, West Springfield, Mass.

Five regional vice presidents also were elected: Lin W. Best, Best

DELEGATES to Lighting Maintenance Contractors conference included membership chairman Walter Fink, Jr., Senior Fluorescent, Atlanta, (right), and Leo Watson, Fluorescent Maint. Co., Denver.

BERNARD BROWN of Phoenix matched maintenance experiences with Mike Alex, Mahoning Lighting & Maint. Co., Warren, Ohio, during meeting of NALMCO members.

Fluorescent Maintenance Co., Temple City, Calif., Western Region; and William W. Kelley, Jr., Fluorescent Maintenance Service, Jackson, Miss., Southern Region; both for 2-year terms, plus John Razzano, Pittsburgh Fluorescent, Renualite, Inc., New Castle, Penn., Eastern Region; Edward I. Creed, C&S Lighting Maintenance, Cleveland, Ohio, Central Region; and Ken Purington, Lighting Sales & Service, Davenport, Iowa, Midwest Region; all for a 1-year term.

In addition to the seven men noted above, the new executive committee will include immediate past president Melvin H. Galbraith, Approved Lighting Service, Cedar Rapids, Iowa, while the positions of directors (of which there formerly were five) will be discontinued henceforth. Other changes in officer status are to the effects that (1) future elections will be by mail ballot to the full membership, rather than being decided only by those in attendance at annual meetings as was formerly the case; (2) regional vice presidents will be nominated by regional memberships, rather than by members-at-large, and (3) all subsequent vice presidents will be elected for 2-year terms so that each Board will include several "holdovers."

Responsible for the success of this meeting, as well as for Association activities during the past year, were committee chairmen Robert L. Merriam, T. L. Rosenberg Co., Oakland, Calif., Program; William Corbett, Outdoor Lighting Service, Concord, Calif., Arrangements; Ken Purington, Lighting Sales & Service, Davenport, Iowa, Finance; Walter C. Fink, Senior Fluorescent, Atlanta, Ga., Membership; Elmo Irwin, Lighting Service, St. Louis, Mo., Sustaining Membership; Her-

bert Mendelsohn, Sun Ray Lighting Corp., Kansas City, Mo., National Accounts; Edward I. Creed, C&S Lighting Maintenance Co., Cleveland, Ohio, Plant Maintenance Show, and Robert E. Watson, Fluorescent Maintenance Co., Denver, Colo., Lamp Contracts.

New Consulting Code Editor

Richard L. Lloyd, electrical safety engineer for the National Bureau of Standards, Washington, D. C., has agreed to serve as a consulting editor and contribute to the "Questions on the Code" department of *Electrical Construction and Maintenance.*

Mr. Lloyd is an acknowledged authority on the National Electrical Code, and is a member of nine code-making panels. He is chairman of CMP No. 4 and is also a member of Correlating Committee of the NFPA National Electrical Code Committee.

Code-making panels periodically review suggested changes to the NEC which have been submitted by interested electrical groups and others. One of the major functions of the Correlating Committee is to review all reports by code-making panels that recommend changes or additions to the NEC, approve them, or direct that they be referred back to the appropriate panel for further study.

Much of Mr. Lloyd's activities at the National Bureau of Standards concerns active participation in forming up-to-date standards for all types of safety codes for industry.

RICHARD L. LLOYD, electrical safety engineer, National Bureau of Standards, Washington, D. C., is a new consulting editor for the Code department of Electrical Construction and Maintenance.

National Electrical Week Promotion

Planning guides and sample materials for the 1962 observance of National Electrical Week will be mailed in mid-October to 5,000 industry leaders and groups throughout the United States and Canada, according to an announcement from Harold A. Webster, chairman of the NEW Committee.

As in the past, the planning guides will be mailed from St. Louis NEW Headquarters, and additional copies will be available for purchase after the initial free distribution.

National Electrical Week will be observed for the seventh consecutive year next February 11-17. Theme for the upcoming observance will be "Electricity Powers Progress."

The planning guide will contain complete information on how individual groups and communities can participate in National Electrical Week, the all-electrical industry event staged each February during the week of Edison's birthday to spotlight the industry and its contributions to our economy and way of life.

In addition to copy and suggested group and community programs, the 1962 NEW Planning Guide will contain illustrations and samples of NEW observance materials that will be available for purchase from the Committee.

A number of standard items will again be offered—speeches, mats, reproofs, Edison replica lamps, electrical home inspection reports, "How to Make a Simple Electric Motor" pamphlets, and general display materials such as window streamers, bumper strips, and easeled cards. In addition, the Committee will offer: decals featuring the theme words "Electricity Powers Progress" for use on automobiles and in store and office windows during and after the observance, placemats featuring a brief electrical quiz and information about the Week, and two interesting new pamphlets designed for students—"How to Make a Simple Buzzer and Code Key" and "How to Make a Simple Electric Battery."

Samples or illustrations of these materials will be included in each planning guide.

National Electrical Week is sponsored by the following industry groups: American Home Lighting Institute, Canadian Electrical Council, Edison Electric Institute, International Association of Electrical Leagues, International Brotherhood of Electrical Workers, National Appliance Service Association, National Association of Electrical Distributors, National Electrical Contractors Association, and the National Electrical Manufacturers Association. The Week is endorsed by 16 other trade groups.

The Committee offices are 290 Madison Ave., New York 17, N. Y. However, anyone wishing further information about National Electrical Week should contact the St. Louis Headquarters, National Electrical Week Com., 407 N. 8th St.

Proposed Amendments Of 1959 NEC

Now available in booklet form is the "Proposed Amendments of the 1959 Edition National Electrical Code," published by the National Fire Protection Association. Designated NFPA No. 70-PR, copies can be obtained at $2.50 each by writing to the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.

This NFPA publication covers the action of code-making panels relative to a large number of suggested code changes submitted by electrical groups and others. For each suggested change, comments of the submitter and the code panel involved are listed. This brings to light the reasons behind many of the code changes that will be included in 1962 edition of the NEC. Also reasons for not accepting certain recommendations for code changes are included.

Comments and recommendations relative to the proposed amendments included in NFPA No. 70-PR should be submitted by December 1, 1961.

Apprenticeship for Electronic Technicians

A report on training electronic technicians through apprenticeship procedures has just been published by the Bureau of Apprenticeship and Training, U. S. Department of Labor. It describes the program used by Raytheon Co. in Massachusetts. The International Brotherhood of Electrical Workers, Local 1515, cooperated with the company in instituting the program.

The new publication outlines the background under which the program evolved, as a result of activities of an electronics industry advisory committee established upon the recommendation of the Massachusetts State Division of Appren-

tice Training. The report issued by the federal apprenticeship agency covers the first three years of operation under the Raytheon program registered with the state of Massachusetts.

Information is given in the report on the methods of selecting apprentices, functions of the joint apprenticeship committee, related instruction outlines, supervisory techniques and apprenticeship records. The document also carries endorsements by the company and union of the objectives and the progress attained under the program to date.

Copies are available without charge, on request to the Bureau of Apprenticeship and Training, U. S. Department of Labor, Washington 25, D. C.

Comments on Identical Prices

"Your editorial 'Identical Prices' in the August 1961 issue of *Electrical Construction and Maintenance* was interesting. The analysis of the electrical industries' pricing system certainly makes sense—for the nongovernmental buyer. The private buyer has two general questions to answer concerning a potential purchase: 1. What quality level shall I buy, and 2. How much shall I pay? As you state in your editorial, the open price lists offered by the vendors serve very well in helping to answer such questions.

"The governmental buyer must, of course, answer the same questions. But he has a third and, to him, a most important question to answer: Whom shall I buy from? When he must have an answer to this question, he may be confronted with four or five vendors all with identical products *and prices*. Should he arbitrarily choose one, the others raise the cry of discrimination. No suitable device for resolving such a dilemma other than competitive bidding has been available. If the received bids are consistently identical then the governmental buyer is forced to choose the supplier—a position he finds to be untenable.

"Certainly, the governmental buyer does not wish to destroy the present price information practice. It does seem, though, that the supplier who is really interested in securing government business would find it possible to depart from his price lists to obtain such business.

"Perhaps a new concept is

needed. What has the supply industry to offer? Until an acceptable alternative is found, the governmental buyer will continue to rely on the free enterprise system."—Howard W. Carmack, assistant superintendent, Electrical Department, City of Oakland, Calif.

Fifth EW Heating Conference Held In Washington

To better coordinate industry efforts in electric heating research and marketing, the Fifth *Electrical World* Electric Heating Conference played host to some 300 electric utility and equipment manufacturer representatives and other industry personnel on September 25-26.

The meeting, co-sponsored by the Commercial and Residential Electric Heating and Air Conditioning Committees of Edison Electric Institute and the Electric Heating Section of NEMA, was held in Washington, D. C., to provide conferees an opportunity to meet with and appraise housing officials of the true facts on electric heat and to learn of the new Administration's housing plans.

After a review of *Electrical World's* recent survey of the electric heating market by Commercial Editor John Damon, the national housing and economic picture was brought into focus by Dr. George Cline Smith, senior partner of MacKay-Shields Associates. In his opinion, the foreseeable demand in housing will be for small units in the lower range, both single and multiple units, to meet the needs of young married people and older retired couples. Statistics show that the middle-age segment of our population will be comparatively static in number for the next few years. From the standpoint of the electric heating industry, such construction represents a prime market.

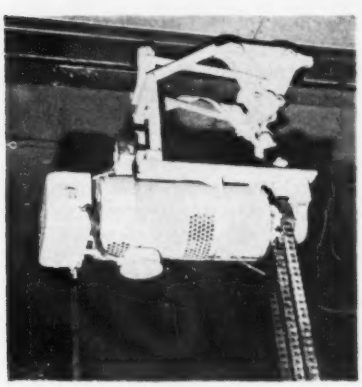
The Administration's housing plans were discussed by William J. O'Connor of FHA, Arthur Dunstan of the Public Housing Administration, and Edward S. Dulcan of the Urban Renewal Administration. Heating standards for federal and public housing, expressed by FHA's Minimum Property Requirements, remain unchanged. Methods of estimating electric heating costs, revised downward in the past, are under constant study, Mr. Dunstan said, with a view toward further

revision to reflect the growing accumulation of experience data.

Louis H. Roddis, president, Pennsylvania Electric Co., outlined his company's sales policies in exploiting the conversion market in an economically depressed area with relatively few annual housing starts. A primary selling tool, he said, is the stable operating cost available with electric heat—something the competition cannot hope to claim.

Main speaker at the opening luncheon was Senator Jennings Randolph of West Virginia, who discussed the controversial national fuels and energy study now underway in the Senate. The purpose of the study, he said, is not "to lay the foundation for a policy which would establish an unjust advantage for the coal industry," nor is it the intent to impose end-use controls on fuels. "Rather, the value of a national fuels and energy policy is that it would enable us to see the direction our economy is taking and to make the necessary economic and social adjustments."

C. E. Anderson, Virginia Electric & Power Co., discussed the importance of the builder and architect as necessary links in the chain to extend electric heat. Builder M. A. Wright of Huntington, W. Va., described his introduction to electric heat and outlined the very successful merchandising tech-



GEAR MOTOR DOUBLES as monorail hoist in the repair shop at Tweedle Electric Motor Service, Lafayette, Ind. Unit rides 30-ft I-beam from sidewalk to shop interior. The ¾-hp. 3-phase, 220-volt, 1200-rpm motor is geared down to 14 rpm; has solenoid-actuated brage; operates roller chain hoist attachment at 14 ft per minute travel; has suspended push-button control. Hoist end of unit is suspended from a 2-ton trolley with tandem attachment to support rest of motor weight. Looped heavy-duty cable to motor is supported by messenger cable.

ATTENDING the recent Fourth Annual Chapter Officers' Conference of EASA in St. Louis were these delegates (from left): Charles E. Smith, J. E. Berger Corp.; and J. R. Watterson, United Electric Motor Service, both of Detroit, Mich., and secretary and president respectively of the Great Lakes Chapter of EASA; and Murphy G. Miller, Jr., Tennessee Electric Motor Service, Knoxville, Tenn., secretary-treasurer, Mid-South Chapter.

niques accompanying his initial ventures. C. S. Buchart of Buchart Associates, architects and engineers, York, Pa., similarly covered his firm's decision to design for electric heat, described completed jobs, and expressed complete satisfaction in the results on the part of his company and the clients served.

Color slides of many commercial installations of electric heat on the Commonwealth Edison Co. lines were shown by Laurence E. Pierron, commercial manager. L. L. Koontz, Appalachian Power Co., described his utility's pursuit of the modernization market, giving interesting figures on conversion costs. As of August, 1961, he stated, Appalachian Power had 6508 electrically heated homes — 4728 new homes and 1780 conversions. At present, 30% of all new homes go in all-electric, with prospects for increasing this figure to above 50% in the near future.

Heating equipment development was covered by Stewart Segerstrom, Lennox Industries, Inc. (the central electric furnace); William L. McGrath, Carrier Air Conditioning Co. (the heat pump); and C. F. Kreiser, Edwin L. Wiegand Co. (the room resistance heater). Ray Edwards, Edwards Engineering Corp., gave a complete rundown on the possibilities of hydronic off-peak storage heating as a solution to utility load factor problems. J. J. William Brown, General Electric Co., described research on new energy devices such as the thermoelectric generator and the fuel cell, adding that radical breakthroughs would be required to make them

suitable for anything but small specialty applications.

The well known contribution of insulation to successful heating installations was reiterated by Fred Sides, National Mineral Wool Assn., followed by a summary of results obtained in the Wood Conversion Co.'s electrically heated test houses by G. A. Erickson.

Speaking at the meeting's final luncheon, Charles F. Hochgesang, editor, *Electrical World*, called for the creation of a single industry organization, the main purpose of which would be to coordinate electric heating research and marketing to match the unified efforts of the gas industry in its drive to expand its share of the heating and appliance market.

Power Sales to Climb 38% by 1965

U. S. electric utilities' energy sales will climb 38% over 1961 to 984 billion kilowatt hours by 1965 according to *Electrical World's* Twelfth Annual Electrical Industry Forecast.

In the long-term outlook, the report predicts energy sales will more than quadruple between 1961 and 1980, going from 713.6 billion kilowatt hours to nearly three trillions —2,914 billion kwhrs.

This point underlines one of the most important forecast findings: electricity's share of the nation's total energy requirements is con-

DELEGATES to the recent Chapter Officers' Conference in St. Louis, the fourth annual meeting of its kind to be sponsored by EASA, heard from past-president Paul Sievert (second from right), Sievert Electric Co., Chicago, Ill., co-general chairman of the 1962 EASA convention. From left: Charles Ferguson, Ferguson Electric Co., Ludington, Mich.; and Norman A. Vliek, Rowen & Blair Electric Co., Kalamazoo, Mich., president and representative respectively of EASA's Western Michigan Chapter; and Connie H. Henry, Motor Rewinding Co., Dallas, Texas, vice-president of EASA's Southwestern Chapter.

AMONG the delegates to the recent Fourth Annual Chapter Officers' Conference of EASA, held in St. Louis, and moderated by EASA International vice-president Ben J. Horton (second from left), The Atkinson Armature Works, Pittsburgh, Kansas, were (from left): Jerry R. Still, of Still's Electric Shop, Decatur, Ill., secretary-treasurer, King Coal Chapter; James W. French, French-Gerleman Electric Co., St. Louis, secretary-treasurer, Greater St. Louis Chapter; and Elroy Reese, Reese Electric Motor Co., Ames, Iowa, secretary-treasurer, Midwestern Chapter.

stantly growing. Today, about 20% of total energy demand is in the form of electricity.

To finance the expansion 1962-65 sales increases alone will require, utilities will invest $22.3 billion in the period, up 17% over capital spending during 1958-61.

During the 1962-65 period, transmission and distribution expenditures will post the greatest increases over spending in the previous four-year period. Distribution expenditures will be 25% higher than they were in the period 1958-61, while transmission expenditures will be up 24%. Generation will be 10% higher during the next four years than it was from 1958 to 1961.

N. Y. Course in Lighting Design

During the Fall of 1961, the Electrical League of New York and the American Institute of Electrical Engineers are jointly sponsoring a course in the Fundamentals of Lighting Design. The course is being presented under the direction of the chairmen of the AIEE educational committee, Henry Wenson, chief electrical engineer of the Port of New York Authority and D. B. Haring, vice-president of Hatzel and Buehler, Inc.

The study group has been designed to provide training in the engineering elements of lighting design. It is intended to prepare those attending for a Spring program on lighting applications in particular fields. This fundamental

ATTENDING the recent Fourth Annual Chapter Officers' Conference in St. Louis were these shop operators (from left): Myron Weaver, Powell Electric Motor Co., Albuquerque, N. M., president of EASA's Rocky Mountain Chapter; and Elroy Reese, Reese Electric Motor Co., Ames, Iowa; and Julian G. Hupp, Electric Motors Co., Cedar Rapids, Iowa; secretary-treasurer and president, respectively, of Midwestern Chapter.

course is made up of six sessions, each running for two hours, from 6:30 pm to 8:30 pm, held on consecutive Wednesdays starting September 27. The program is as follows:

Session 1—*Science of Lighting.* A description and demonstration of the physical factors involved in seeing.

Session 2—*Lighting Fundamentals.* Definition of terms and basic formulae involved in lighting calculations.

Session 3—*Lighting Design.* Factors involved in the use of basic formulae.

Session 4—*Light Sources.* A survey and demonstration of the various lamps.

Session 5—*Control of Light.* Glass and plastic lenses, louvers, etc., and various media for the control of light.

Session 6—*Circuit Design.* Design of lighting branch circuits, with code data.

NE Code Course in New Jersey

For the second year, the New Jersey Chapter, Eastern Section, of the International Association of Electrical Inspectors is sponsoring a six-session course in the National Electrical Code. This year's course started on September 25 and following sessions will be held on two-week intervals. Each session runs from 7:30 pm to 9:30 pm.

This course is designed to give electrical contractors, consulting engineers, plant electrical men and electrical inspectors an analytical understanding of National Electri-

cal Code requirements as they affect design and construction of modern electrical systems. Each student is provided with a code book for use during the course.

The instructor for the course is Joseph F. McPartland, Associate Editor of *Electrical Construction and Maintenance.* Alvin DeLoach, northern New Jersey supervisor for the Middle Department Association of Electrical Inspectors, the inspection agency covering the area in which the students work, is in attendance at all meetings to answer questions.

EASA News

A number of EASA chapters are opening their 1961-62 chapter years with fall meetings after a summer hiatus. Included in the large number of conferences scheduled for October and November are these:

October 11, Northern California Chapter, in San Jose, Calif.;
October 12, King Coal Chapter, in Madisonville, Ky.;
October 13-14, Heart of America Chapter, in Joplin, Mo.;
October 19, New York Metropolitan Chapter, in New York City;
November 2-4, Southeastern Chapter, in Atlanta, Ga.;
October 19, New York Metropoli- Chapter, in New York City;
November 2-4, Southeastern Chapter, in Atlanta, Ga.;
November 8, Quaker City Chapter, in Philadelphia, Pa.; and November 8, Central Ohio, in Columbus, Ohio.

ATTENDING the recent meeting in St. Louis of EASA chapter officers—the Fourth Annual Chapter Officers' Conference—were these Ohio delegates (from left): Don Fowler, Reserve Electric Co., Cleveland; and Ralph G. Hoskin, The A-C Supply Co., Akron, president and secretary respectively of Greater Cleveland Chapter of EASA; and Don Osenbaugh, J. L. Hughes Co., and Robert J. Langhirt, both of Columbus, and secretary and president respectively of the Mid-Ohio Chapter.

FROM the Northeastern states, five electrical apparatus service shop men attended the recent Fourth Annual Chapter Officers' Conference of EASA in St. Louis. They were (from left): W. Bruce Byrnes, Electric Motors, Inc., Fitchburg, Mass., vice-president, New England Chapter; James Previty Sr., Penn Electric Motor Co., Philadelphia, Pa. president, Quaker City Chapter; Ralph Mollet, Flushing Electric Co., Flushing, N. Y., president New York Metropolitan Chapter; Frank L. Johns, B&J Electric Motor Repair Co., Ansonia, Conn.; and Joseph J. Previte, a Jackson Heights, N. Y., lawyer, who is executive secretary of the New York Metropolitan Chapter.

EASA's board of directors will hold its mid-year meeting in St. Louis on November 17-18 at Clayton Inn.

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Thirty-six presidents and secretaries of 27 of EASA's 39 chapters attended the 4th Annual EASA Chapter Officers' Conference, held in St. Louis on September 8-9 at Clayton Inn.

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Another series of Electronic Motor Control Courses, including an advanced course for graduate engineers or those who have completed the EASA basic course, will be announced shortly, it has been learned. Cleveland, Ohio; Houston, Texas; Seattle, Wash.; New York

DELEGATES to the recent Fourth Annual Chapter Officers' Conference of EASA in St. Louis included (from left): A. J. Kuzniewski, Quality Electric Service, Milwaukee, Wis.; and Jerome P. Miller, Electric Motors Unlimited, Madison, Wis.; president and secretary respectively of EASA's Wisconsin Chapter; and F. E. Cook, president, Southeastern Chapter.

City; Chicago; Atlanta, Ga.; and San Francisco, Calif., have been named as probable sites for the courses which will be held in early 1962.

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EASA's chapter officers passed a resolution at their recent St. Louis meeting endorsing the association's management seminars which were held earlier this year. Another series of these sessions, conducted for shop executives by the faculty of St. Louis University's School of Commerce and Finance, is expected to be announced later in the year.

Ten EASA chapters now regularly publish newsletters, according to EASA headquarters. These include Central Ohio, Great Lakes, Heart of America, Midwestern, New England, New York, Quaker City, Southeastern, Southwestern and Wisconsin chapters.

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At a meeting held in Duluth, Minn., on September 15-16, members of the North Central Chapter of EASA toured the plant of the Reserve Mining Co.

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Contributions to the EASA file of motor data, are mailed from some of the association's 1,600 members almost daily. In July, for example, one shop, the Lima Armature Works, Lima, Ohio, sent 680 cards of 3-phase motor data to EASA headquarters.

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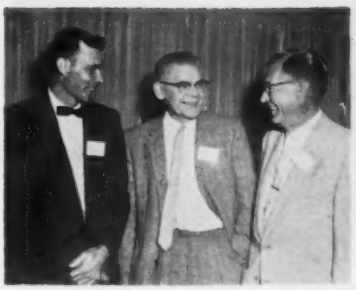
At the August 21 meeting of six EASA chapters, shop operators and employees were entertained by Romanoff Electric Co., Toledo, Ohio. Members from EASA's Cincinnati, Cleveland, Indiana, Cen-

WEST COAST delegates to the recent Fourth Annual Chapter Officers' Conference held in St. Louis included (from left): Lloyd S. Cope, Advance Electric Co., Anaheim, Calif,; and H. Orville Stump, Stump Electric Co., Los Angeles, Calif., vice-president and president respectively of EASA's Los Angeles Chapter; Hal Tingestrom, Tingestrom Electric Co., Centralia, Wash., president, Puget Sound Chapter; and Jack W. Calhoun, Calhoun Electric Co., Coquille, Ore., president, Oregon Chapter.



DELEGATES from two countries attended the recent Fourth Annual Chapter Officers' Conference of EASA in St. Louis, including (from left): Theodore L. Waffle, Waffle's Electric, Ltd., Toronto, Ont., treasurer, Ontario Chapter; John B. Winkle, J. B. Winkle Co.,. Youngstown, Ohio, secretary-treasurer, Youngstown Chapter; and R. R. Dumbaugh, Dumbaugh Electric & Machinery Co., Butler, Pa., president, Tri-State Chapter.

tral Ohio, Western Michigan and Great Lakes Chapters attended.

• • • •

An analysis of registrations at the last two EASA conventions, in Miami in 1960, and in San Francisco in 1961, showed Illinois to be the leader in total registrations excluding the host states of Florida in 1960 and California in 1961. Ohio and New York also finished strong in both years.

The next EASA convention will be held in Chicago at the Conrad Hilton on June 10-13, 1962.

• • • •

Among the new members of EASA are The Epoxylite Corp., El Monte, Calif., and Core Manufacturing Co., Washington, Mo., both having been admitted as associate members.

• • • •

Another new member of the association is a motor shop from the fiftieth state, Ken's Electric Service, Honolulu, Hawaii. Ken Yee is the owner.

• • • •

EASA President George Larsen has addressed meetings of the association in St. Louis, Los Angeles and Duluth, Minn., and expects to be spending much of his time on the road between now and the end of the year. His next meetings include the ones at Joplin, Mo., and Kingston, Okla.

• • • •

The new executive vice-president, August A. Baechle, has also been busy flying to various sections of the country to address shop gatherings. His itinerary has included a stop in Chattanooga, Tenn., and will also include the meetings in Joplin and Kingston as well as one in Atlanta, Ga.

DATES AHEAD

Electrical Apparatus Service Association — Chapter meetings — Northern California, San Jose, Calif., October 11; King Coal, Madisonville, Ky., October 12; Heart of America, Joplin, Mo., October 13-14; New York Metropolitan, New York City, October 19; Southeastern, Atlanta, Ga., November 2-4; Quaker City, Philadelphia, Pa., November 8; Central Ohio, Columbus, Ohio, November 8.

International Association of Electrical Inspectors—Southern Section, Grove Park Inn, Asheville, N. C., October 16-18; **Western New York,** Buffalo, N. Y., October 25; **North Central Div.,** Fort Worth, Texas, November 3; **Nebraska,** Grand Island, Neb., November 6-7; **Southern California,** Glendale, Calif., November 8; **Canadian Section,** King Edward Hotel, Toronto, Ont., November 17-18; **Illinois,** Morrison Hotel, Chicago, Ill., February 1-2; **Joint Five Chapters,** Shreveport, La., April 27-28.

National Fire Protection Association—Fall conference, Hotel President, Kansas City, Mo., October 30-November 1.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 13-17.

Plant Engineering & Maintenance Show — Convention Hall, Philadelphia, Pa., January 22-25, 1962.

Electrical Engineering Exposition—Sponsored by AIEE, New York Coliseum, New York, N. Y., January 29-February 2.

National Industrial Electric Heating Conference — Netherland-Hilton Hotel, Cincinnati, Ohio, February 5-8.

National Electrical Week—National promotion, February 11-17.

Air Conditioning, Heating, and Refrigeration Industry—12th Exposition, Los Angeles, Calif., February 12-15.

Upper Midwest Electrical Industry Convention — Radisson Hotel and Municipal Aud., Minneapolis, Minn., February 18-21.

Sacramento Valley Electrical League—Progress in Electrical Equipment Exhibit, Sacramento Inn, Sacramento, Calif., February 28-March 2.

Sixth National Electrical Industries Show — New York Coliseum, New York, N. Y., March 11-14.

2nd NEMA National Electric Comfort Heating Exposition and Symposium—Sherman Hotel, Chicago, Ill., March 19-21.

11th Biennial Electrical Industry Show—Shrine Exposition Hall, Los Angeles, Calif., March 28-31.

National Association of Electrical Distributors — Convention, Pittsburgh, Pa., May 12-16.

National Fire Protection Association—66th annual meeting, Sheraton Hotel, Philadelphia, Pa., May 21-25.

Electrical Apparatus Service Association—Convention, Conrad-Hilton Hotel, Chicago, Ill., June 3-7.

YOU ASKED FOR IT— the May 1960 feature section of Electrical Construction and Maintenance now in a handsome hard-cover book.

CONSTRUCTING ELECTRICAL SYSTEMS

by J. F. McPartland and the Editors of Electrical Construction and Maintenance

Here's a modern, comprehensive reference and instruction manual on the methods and techniques used in constructing systems for power, light, signals and communications. Covering the best practice on selecting, mounting, connecting and housing all types of electrical equipment, **this manual presents *1959 National Electrical Code data* relating to installation. And a wealth of special illustrations are used throughout to clarify fine code points.**

Chapters are broken down on the basis of types of equipment to facilitate ready reference: lighting equipment – motors and controllers – conductors – raceways – switches – overcurrent protective devices – switchboards and panelboards – transformers – capacitors and regulators – power sources – high voltage – signals and communications.

CONTRACTORS – Get copies of this book for your job superintendents, foremen and estimators. They'll appreciate the gesture and you'll get a high return on your investment.

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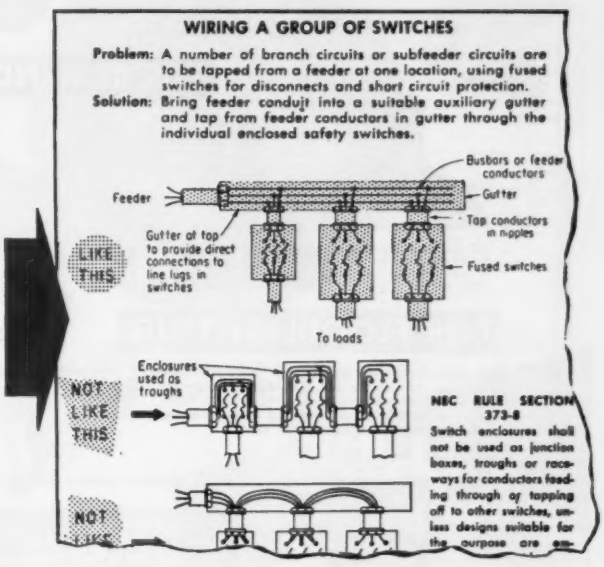

PLANT ELECTRICAL PEOPLE – This book should be in the reference library of plant electrical engineers, electrical supervisors and electricians.

ELECTRICAL INSPECTORS – Here's a unique presentation of code rules in combination with specific installation details taken from modern practice. The correlation between code generalities and actual job specifics will assist inspectors in many difficult rulings.

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Among the Manufacturers

Headquarters Announcements

General Electric Co., Louisville, Ky.—Dabney Tunis, manager of advertising and sales promotion, Residential Market Development Operation.

Progress Manufacturing Co., Philadelphia, Pa.—Lester M. Benjamin, market development director.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.—John Maislinger, chief development engineer, Precision Meter Div.

Imperial Electric Co., Akron, Ohio—Edward A. Kitsch, sales manager.

Minnesota Mining & Mfg. Co., St. Paul, Minn.—Raymond H. Herzog and Harry Heltzer, vice presidents; E. J. Kane, A. H. Redpath and R. W. Adam, divisional vice presidents.

Moloney Electric Co., St. Louis, Mo.—William H. Schiek, manager of sales, Switchgear Div.

General Electric Co., Tyler, Texas—Robert A. Sestero, manager of advertising and sales promotion.

I-T-E Circuit Breaker Co., Philadelphia, Pa.—William G. Long, manager, Transformer and Rectifier Div.

Reliable Electric Service, Inc., Reading, Pa.—Donald O. Eschbach, general manager.

Sigma Instruments, Inc., South Braintree, Mass.—John J. Moran, executive vice president.

Norris-Thermador Corp., Los Angeles, Calif.—John F. Sorenson, heat pump and air conditioning sales manager, Thermador Div.

American Enka Corp., Concord, Mass.—R. J. Rodday, director of marketing and T. M. Hinds, director of manufacturing of the Brand-Rex Div.

National Carbon Co., New York, N. Y.—William C. McCosh, director of marketing.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—T. D. Lyons, vice president, administration, Industries Group; Walter L. Peterson, manager of motor and generator department, Industrial Equipment Div.; Gordon W. Clothier, manager of transformer planning, Power Equipment Div.; Will Mitchell, Jr., director, Research Div.

Westinghouse Electric Corp., Bloomfield, N. J.—Harry L. Nie-

derauer, manager of marketing services, Lamp Div.

Electric-Autolite Co., Toledo, Ohio—Paul F. Allmendinger, director of engineering, electrical products group.

Square D Co., Cleveland, Ohio—Paul R. Goudy, manager, Electric Controller & Manufacturing Div.

Sierra Electric Corp., Gardena, Calif.—Robert E. V. Ramsing, vice president of sales.

Worthington Corp., Harrison, N. J.—Vincent deP. Gerbereux, director of marketing services; Peter S. Barno, vice president of employee and public relations; Patrick L. McManus, general manager of Standard Pump Div. at East Orange, N. J.

Regional Appointments

NEW ENGLAND

Valley Manufacturing Co.: Dudley Collier, Billerica, Mass., representative, Steel Lighting Standard Div.

Spring City Electrical Mfg. Co.: Herbert Madden Co., Inc., Charlestown, Mass., sales representative in New England area with the exception of Connecticut.

MIDDLE ATLANTIC

Minneapolis-Honeywell Regulator Co.: C. T. Morison, branch sales manager for New York office, Micro Switch Div.

Standard Transformer Co.: R. A. Keeler, district manager of New York office in charge of New York, New Jersey and Connecticut areas.

Consolidated Pipe Co. of America: Paul F. Gallagher, Philadelphia, Pa., representative for eastern Pennsylvania and southern New Jersey.

Trade Service Publications, Inc.: Robert E. Baumgarten, representative in the Middle Atlantic states.

SOUTH ATLANTIC

Minneapolis-Honeywell Regulator Co.: Floyd M. Cassidy, branch sales manager in Washington, D. C., Micro Switch Div.

Valley Manufacturing Co.: Osgood & Associates, Atlanta, Ga., representative in Georgia, Alabama, Florida and eastern Tennessee; Campbell & Woods Agency, Cary, N. C., representative for Maryland, Virginia, North and South Carolina, Steel Lighting Standard Div.

Feedrail Corp.: Shannon Associates, Orlando, Fla., representative.

EAST CENTRAL

Siegler Corp.: Wayne Beitel, Detroit, Mich., sales representative, Bogen-Presto Div.

Sola Electric Co.: Dynamic Industries Sales Corp., Detroit, sales representative for entire state of Michigan.

Rockbestos Wire & Cable Co.: Roy S. Williamson, sales manager of Upper Midwest district, with headquarters in Chicago.

Wheelock Signals, Inc.: Electrical Materials Co. and Grant Shaffer Co., both of Detroit, sales representatives.

Dayco Corp.: Charles Hunt, district manager in Indiana, Industrial Div., with headquarters in Indianapolis.

Allis-Chalmers Mfg. Co.: Donald J. Powers, resident representative in Fort Wayne, Ind.

WEST CENTRAL

Allen-Stevens Conduit Fittings Corp.: Schooler-Gorman Co., Kansas City, Mo., sales representative for Iowa, Kansas, western Missouri and Nebraska; Ajax Electric Sales Agency, St. Louis, Mo., sales representative for southern Illinois, eastern Missouri and Memphis, Tenn.

Consolidated Pipe Co. of America: Ivan Boggs & Co., Springfield, Mo., representative in Missouri, Kansas and northern Arkansas.

Columbia Cable and Electric Corp.: Stein & Jensen Sales Co., St. Paul, Minn., representative in North and South Dakota, Minnesota and western Wisconsin.

Kirlin Co.: Whitlow-Briscoe Co., Dallas, representative in northern and west Texas.

WEST

Standard Transformer Co.: W. A. Dolde Sales Co., Albuquerque, N. M., representative.

General Electric Co.: John F. Hippen, western region manager for Residential Market Development Operation, with headquarters in San Francisco.

Allen-Stevens Conduit Fittings Corp.: H. M. Denny Co., Seattle, sales representative for Alaska, Idaho, Montana, Oregon and Washington.

Struthers-Dunn, Inc.: R. P. McAlister, Pacific Coast sales manager, with headquarters in Encino, Calif.

Electromode: Donald S. Gleason & Associates, Seattle, sales representatives in the Pacific Northwest covering Oregon, Washington, northern Idaho and Alaska.

EFFECTIVE MAINTENANCE

[FROM PAGE 119]

cludes periodic cleaning, changing of tubes, and recording of test-point readings according to voltage and resistance check charts. One of our employees is a meter specialist who calibrates all meters and recording equipment once a month. He has a good knowledge of electronics and will troubleshoot electronic equipment when necessary.

What electrical maintenance do you perform on resistance-type heat-treat furnaces?

About once a month we check the heating-element connections for corrosion or signs of overheating. At the regularly scheduled inspection, the brickwork is checked or repaired, particularly in the area where the heating-element supports are mounted. If these supports loosen, the heating elements may sag and contact an adjacent element. This undesirable contact may cause hot spots to develop, which will eventually result in a burned-out element.

The main contactors, which make and break the low-voltage, high-current power, are inspected and cleaned once a month. Temperature controls are inspected and adjusted by our meter specialist.

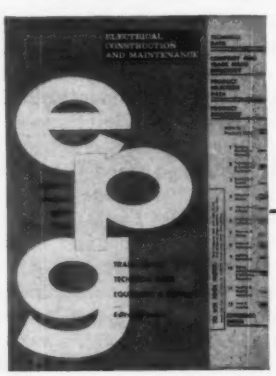
What electrical maintenance do you perform on the high-frequency induction-heating equipment?

Our induction-heating equipment is used to harden metal parts for production. A typical installation has a 440-volt 3-phase 150-hp induction motor driving a 100-kw 9600-cycle generator. From the generator, water-cooled busbars supply a water-cooled induction coil constructed of copper tubing. Capacitors, connected in parallel with the work coil, correct the inherent lagging power factor. And a control panel, which regulates the generator output, houses contactors, relays and meters.

All of this equipment receives a thorough inspection monthly. The sleeve-bearing oil level on the motor-generator set is checked and the oil is changed when it is dirty. At the busbars, resistance to ground and across the capacitors is checked and recorded after the capacitors are disconnected. Other maintenance procedures include cleaning the control panel, and inspecting relay contacts, overload relays and similar control devices.

Advertising In This Issue

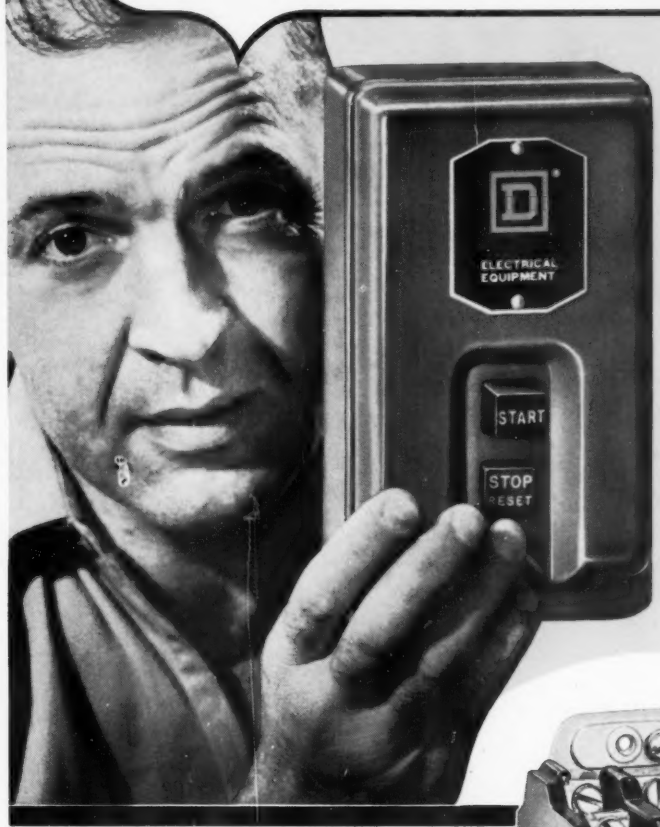
■



• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

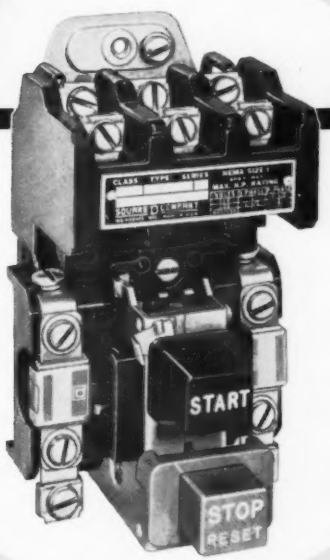
This NEW Manual Starter has EVERYTHING!



NEMA Sizes 0 and 1

Two, three and four-pole construction

- ***SMALLER!*** Takes less space, whether it's built into machine or mounted externally
- ***SMART STYLING!*** Matches the streamlined appearance of today's modern machines
- ***QWIK-MAKE, QWIK-BREAK!*** Positive snap-action opening and closing of contacts. Longer contact life
- ***TRIP-FREE OVERLOAD PROTECTION!*** Impossible for operator to hold motor circuit closed against overload
- ***POSITIVE PROTECTION!*** Starter will not operate *without* overload units installed
- ***LONGER LIFE!*** *Toggle Action* operating mechanism. Heavy-duty construction throughout
- ***EASIER INSTALLATION!*** Wire it without removing starter from enclosure. All terminals have pressure wire connectors



- ***EASIER MAINTENANCE!*** "Off-the-Shelf" parts kits make normal maintenance and modifications easier than ever. They're easy to buy, easy to identify, and faster to install
- ***TAMPER-PROOF!*** Cover padlocking device prevents tampering by unauthorized personnel. Safety latch locks "start" button in "OFF" position
- ***VISIBLE INDICATION OF OVERLOAD!*** Self-centering push-buttons show when overload has occurred

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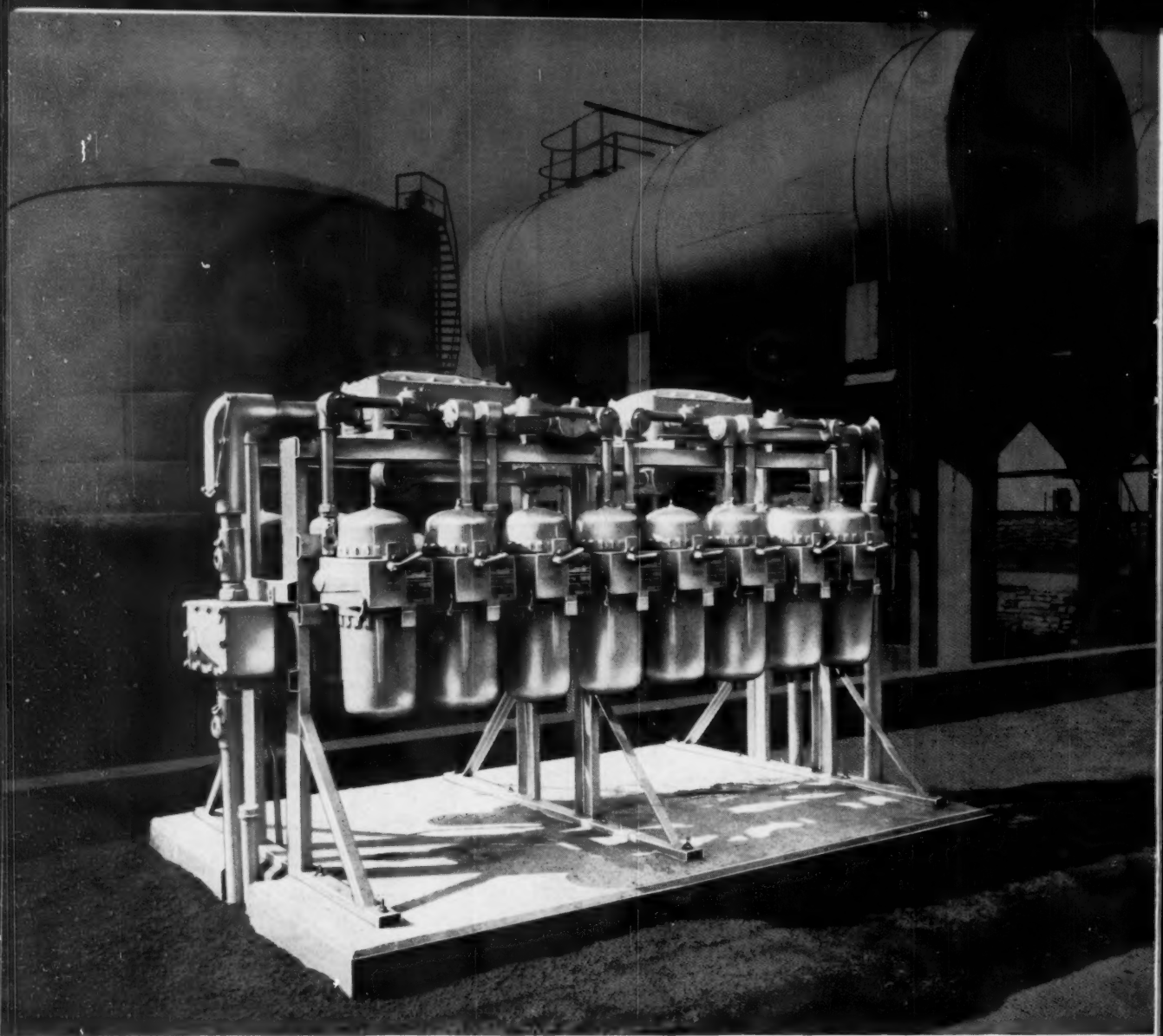

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